INSTALLATION RESTORATION PROGRAM

PHASE I - RECORDS SEARCH

DULUTH IAP, MINNESOTA

AD A113611

DTIC FILE COPY

ARED FOR

UNITED STATES AIR FORCE
AFESC/DEV
Tyndall AFB, Florida

and

HQ TAC/DEE
Langley AFB, Virginia

DTIC ELECTE APR 20 1982 E

ES ENGINEERING-SCIENCE

"Original contains color plates: All DTIC reproductions will be in black and white"

MARCH, 1982

82 04 19 145

INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
DULUTH IAP, MINNESOTA

Prepared For

United States Air Force
AFESC/DEV
Tyndall AFB, Florida
And
HQ TAC/DEE
Langley AFB, Virginia

March, 1982

By

ENGINEERING-SCIENCE, INC.
57 Executive Park South, N.E.
Suite 590
Atlanta, Georgia 30329

This report has been prepared for the U.S. Air Force by Engineering-Science for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force or the Department of Defense.

ES ENGINEERING-SCIENCE

57 EXECUTIVE PARK SOUTH, N.E., SUITE 590 • ATLANTA, GEORGIA 30329 • 404/325-0770
CABLE ADDRESS: ENGINSCI
TELEX: 54-2882

March 26, 1982

Mr. Myron Anderson
AFESC/DEVP
Tyndall AFB, Florida 32403

Dear Mr. Anderson:

Enclosed is the Engineering-Science, Inc. (ES) final report entitled "Installation Restoration Program, Phase I, Records Search, Duluth International Airport, Minnesota." This report has been prepared in accordance with the ES' proposal dated November 13, 1981 and the Air Force Contract number F08637-80-G0009, Call #0012.

Presented in this report are introductory background information on the Installation Restoration Program, a description of the Duluth International Airport (IAP) including past activities, mission and environmental settings, a review of industrial activities at Duluth, an inventory of major solid and hazardous waste from past activities, a review of past and present waste handling, treatment and disposal facilities, an evaluation of the pollution potential of waste disposal sites, and recommendations for the Installation Restoration Program, Phase II, Problem Confirmation and Quantification.

We enjoyed the opportunity to work with you and the Duluth IAP personnel who contributed information for the completion of this assessment. Please refer any questions concerning this report to Public Affairs at Headquarters TAC (TAC/PAPM) Langley AFB, Virginia.

Very truly yours,

ENGINEERING-SCIENCE, INC.

Gary Christopher

W. G. Christopher, P.E.
Project Manager

WGC/jhw

Enclosure

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

In 1976, the Department of Defense (DOD) devised the Installation Restoration Program (IRP) to identify, report and correct potential environmental deficiencies from past waste management activities that could result in hazards to health or environment or possible migration of hazardous contaminants. The IRP is a four-phase program consisting of Phase I, Problem Identification/Records Search, Phase II, Problem Confirmation and Quantification, Phase III, Technology Development and Phase IV, Corrective Action. Engineering-Science (ES) was retained by the Air Force Engineering and Services Center to conduct the Duluth IAP Records Search under Contract No. F08637-80-G0009, Call No. 0012, using funding provided by the Air Force Tactical Air Command.

INSTALLATION DESCRIPTION

The Duluth International Airport (IAP) is located in northeastern Minnesota, approximately seven miles northwest of the City of Duluth and the western end of Lake Superior. Duluth IAP was operated jointly by the Air Force, Air National Guard, and the City of Duluth. The airport encompasses 1,995 acres. The basic mission of Duluth IAP was to provide support for the 23rd North American Air Defense (NORAD)/Air Division and other major Air Force tenant organizations. The Air Force is in the process of being inactivated and will cease operation on March 31, 1982. The installation will be on care-taker status until eventual disposal by the General Services Administration.

ENVIRONMENTAL SETTING SUMMARY

Several environmental setting conditions noted at Duluth IAP need to be considered when handling and disposing of hazardous waste materials. These are as follows:

- The primary area aquifer, the glacial drift aquifer, underlies the installation at ground surface. The aquifer is essentially unprotected from potential contamination by surface infiltration; water levels are reported to be shallow (six feet or less).

- The rock aquifer is in close communication with the glacial drift aquifer.
- The base is located in a ground-water discharge zone.
- Duluth IAP and most adjacent communities receive water supplies from municipal sources obtained from Lake Superior. Isolated domestic and agricultural activities derive water resources from local aquifers, principally the glacial drift.
- Domestic wells do exist within one mile of the base.
- The average annual net precipitation rate is 10 inches.
- Wetlands exist on Duluth IAP.
- There are no known threatened or endangered plant species on Duluth IAP. The only animal species in this category with any significant chance of being found within the Duluth area are the timber wolf and several species of predator birds. These birds include the golden eagle, the bald eagle and the peregrine falcon. Even though these birds are rare, high numbers may migrate through the Duluth area each fall.

The above points indicate the potential for the migration of contamination to area aquifers due to past waste disposal practices is moderate. As the base is situated in a suspected groundwater discharge zone, contaminants entering the upper aquifer would probably be discharged to local streams or to the numerous swamp areas present. The primary environmental concern, therefore is judged to be to the quality of local surface waters, should the potential for the migration of waste contamination be demonstrated.

METHODOLOGY

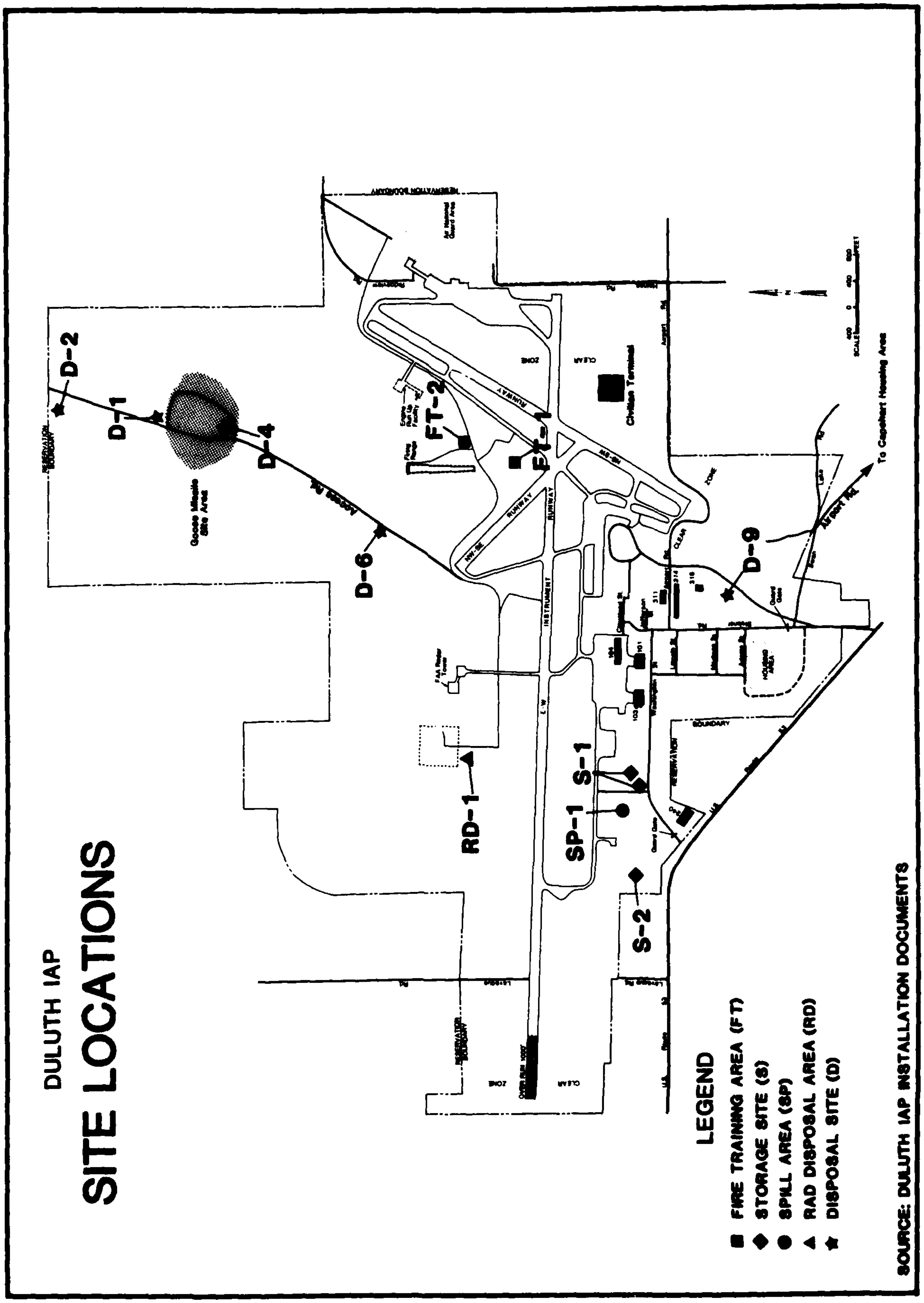
Interviews were conducted with base personnel (past and present) familiar with past waste disposal practices, file searches were performed for facilities which have generated, handled, transported, and disposed of waste materials, interviews were held with local, state and federal agencies, and site inspections were conducted at facilities that have generated, treated, stored, and disposed of hazardous waste. Eleven sites located on the Duluth IAP property were identified as containing hazardous waste that could result in migration of contaminants (Figure 1). These sites have been assessed using a rating system which takes into account factors such as site characteristics, waste characteristics, potential for contamination and waste management practices. The details of the rating procedure are presented in Appendix G and the results of the assessment are given in Table 1. Rating scores were developed for the individual sites and the sites are listed in order of ranking. The rating system is designed to indicate the relative need for more detailed site investigation due to potential environmental hazards.

FINDINGS AND CONCLUSIONS

Based on the results of the project team's field inspection, review of records and files, and interviews with base personnel, the following conclusions have been developed. The conclusions are listed by category.

1. Disposal and Dump Sites
   a. Disposal Site D-1 has a moderate potential for migration of contaminants.
   b. Disposal sites D-6, D-4, D-2 and D-9 have a low potential for migration of contaminants.
2. Fire Training Areas
   Fire training areas FT-2 and FT-1 have a moderate potential for migration of contaminants.
3. Spill Area
   Spill area SP-1 has a moderate potential for migration of contaminants.
4. Radioactive Disposal Site
   The radioactive waste disposal site has a low potential for contaminant migration.
5. Hazardous Waste Storage Areas
   a. The DPDO storage area "C" (Site S-2) has a moderate potential for contaminant migration.
   b. The old DPDO storage area (Site S-1) has a low potential for migration of contaminants.
6. Other sites are not considered to pose a significant hazard of contaminant migration.

FIGURE 1



ES ENGINEERING-SCIENCE

TABLE 1

PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site Name	Score
1	D-1 Goose Missile Site Dump	64
2	FT-2 Fire Training Area	63
3	FT-1 Fire Training Area	56
4	S-2 DPDO Storage Area "C"	55
5	SP-1 Tank Farm Area	53
6	D-4 South Goose Missile Site Dump	50
7	D-2 Goose Missile Site Dump	49
8	D-6 Runway 13 NE Disposal	48
9	S-1 Old DPDO Storage Area	48
10	D-9 Disposal Pit	44
11	RD-1 Low-Level Radioactive Waste Disposal	44

Note: This ranking was performed according to the Hazardous Assessment Rating Evaluation Methodology described in Appendix G. Individual site rating forms are in Appendix H.

Recommendations for further investigation in Phase II are listed in Table 2. These recommendations include ground-water monitoring and surface water and sediment monitoring.

TABLE 2

RECOMMENDED MONITORING PROGRAM FOR PHASE II - DULUTH IAP

Site	Rating Score	Recommended Monitoring	Comments
Goose Missile Dump Site D-1	64	Collect approximately ten surface water and sediment samples at equidistant locations throughout the dump site and analyze for the parameters in List B of Table 6.2.	
Fire Training Site FT-2	63	Install monitoring well system consisting of 1 upgradient well and 3 downgradient wells to an approximate 20 feet depth. Analyze samples for parameters in List A of Table 6.2.	
Fire Training Site FT-1	56	Collect three soil core boring samples of approximate 10 feet depth around the FT-1 site. Analyze these samples for the parameters in List A of Table 6.2.	If the core boring soil samples indicate contamination, a more extensive monitoring program will be required.
DPDO Storage Area "C" Site S-2	55	Collect four soil core borings samples of approximate 10 feet depth around the DPDO storage area "C" Site. Analyze these for the parameters in List A of Table 6.2.	Same as comment above.
Tank Farm Area Site SP-1	53	Install monitoring well system consisting of 1 upgradient well and 3 downgradient wells to an approximate 20 feet depth. Analyze samples for parameters in List A of Table 6.2.	

SECTION 1

INTRODUCTION

SECTION 1
INTRODUCTION

AUTHORITY

In 1976 the DOD devised a comprehensive Installation Restoration Program (IRP). The purpose of the IRP is to assess and control migration of environmental contamination that may have resulted from past operations and disposal practices on DOD facilities, and probable migration of hazardous contaminants. In response to RCRA and in anticipation of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (Superfund), the DOD issued DEQPPM 80-6 (June 1980 Defense Environmental Quality Program Policy Memo) requiring identification of past hazardous waste disposal sites on DOD agency installations. The U.S. Air Force implemented DEQPPM 80-6 by message in December, 1980. The program was revised by DEQPPM 81-5 (11 December 1981) which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 by message 21 January 1982.

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phase program as follows:

Phase I - Problem Identification/Records Search
Phase II - Problem Confirmation and Quantification
Phase III - Technology Base Development
Phase IV - Corrective Action

The Problem Identification/Records Search phase (Phase I) will determine:

1. The hazardous materials which have been used on the installation;

2. Waste management practices;

3. The adequacy of waste management procedures to immobilize, contain, treat, destroy or detoxify the waste;

4. Potential pathways of waste migration;

5. Potential effects of discharge or release of the wastes,

The purpose of this report is to summarize and evaluate the information collected during Phase I of the IRP.

Future Phase II, Phase III and Phase IV efforts will be directed as required towards:

1. Actions necessary to confirm the existence and extent of an identified potential contamination problem (Phase II)
2. Technical base development and alternative analysis to control the contaminant problem (Phase III).
3. Corrective measures as necessary to remedy the problem (Phase IV).

Phase I Project Description

The goal of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Duluth IAP, and to assess the probability of contaminant migration beyond the installation boundary. The activities undertaken by Engineering-Science (ES) in Phase I included the following:

- Review site records
- Interview personnel familiar with past generation and disposal
- Inventory wastes
- Determine quantities and locations of past hazardous waste storage, treatment and disposal
- Evaluate disposal practices and methods
- Conduct field inspection
- Gather pertinent information from federal, state and local agencies
- Assess potential for contamination
- Determine potential for hazardous contaminants to migrate

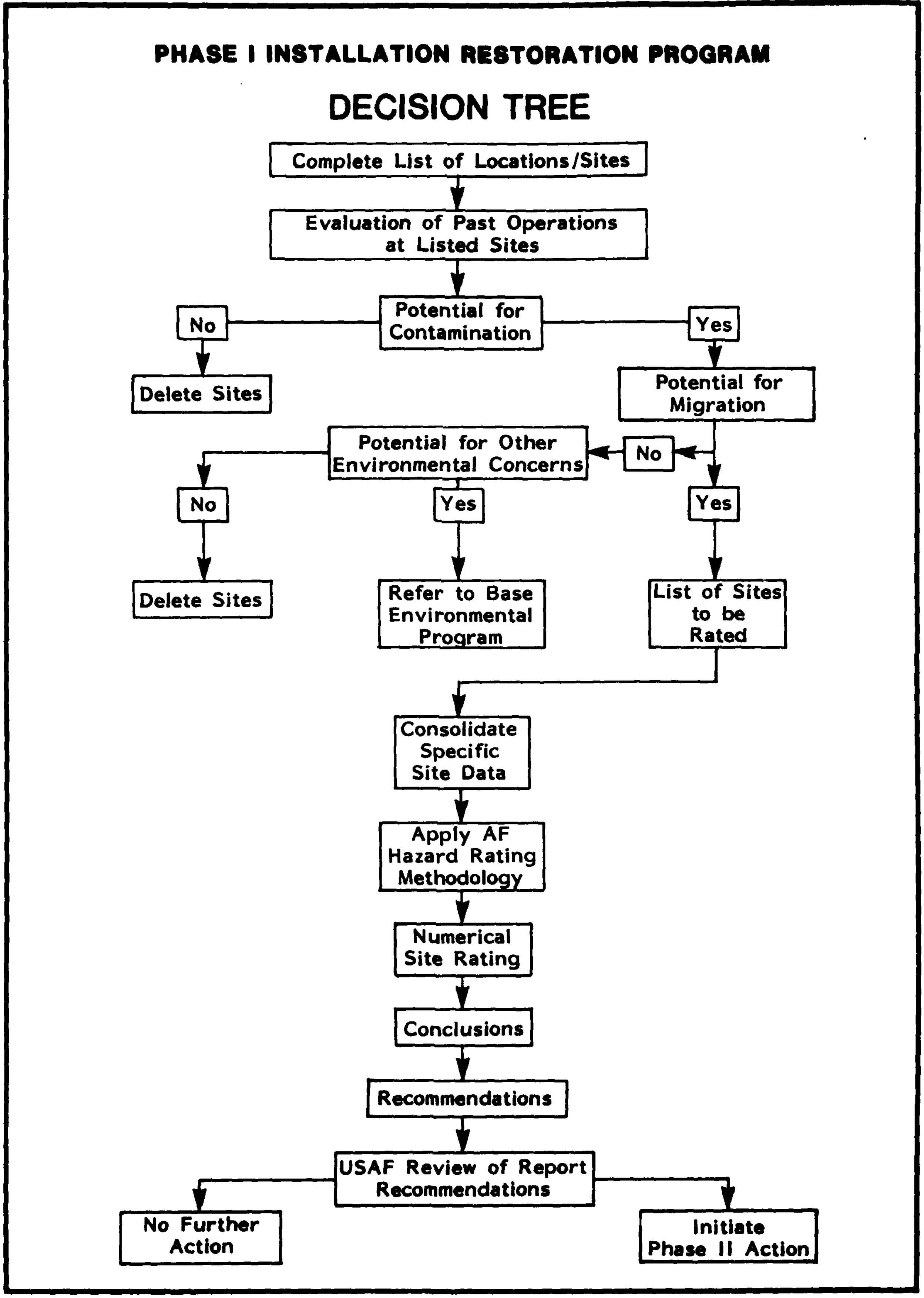
In order to perform the on-site portion of the Records Search phase, ES assembled the following core team of professionals whose qualifications are presented in Appendix A:

- W. G. Christopher, Environmental Engineer and Project Manager, ME, 6 years of professional experience
- J. R. Absalon, Hydrogeologist, BS Geology, 9 years of professional experience
- D. G. Johnson, Environmental Engineer, MSCE, 4 years of professional experience

The on-site portion of the Records Search phase was performed at Duluth IAP in January of 1981. During this period formal interviews were conducted with base personnel. File searches were conducted within several organizations which generate, handle, transport, and dispose of hazardous waste materials. On-site visits and field reconnaissance were conducted at all identified facilities that treated, stored or disposed of hazardous materials. These facilities include landfills, waste treatment facilities, material storage areas, laboratories, industrial shops and other support facilities. The information collected during this intensive records search is summarized and evaluated in subsequent sections of this report.

METHODOLOGY

The methodology utilized in the Duluth IAP Records Search is illustrated by the decision tree in Figure 1.1. This tree provided a logical algorithm for the consistent evaluation of all base practices. First of all, a review of past and present industrial operations was conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with past and present base employees from the various operating areas of the base. The interviewees included current and past environmental personnel associated with the Civil Engineering Squadron, Bioenvironmental Engineer's office, and the Directorate of Maintenance. Several current or past personnel associated with the wastewater treatment plant, the pesticide operations, fuels management and the base solid waste disposal areas were interviewed. Finally, experienced personnel from the tenant organizations were interviewed. Concurrent with the


PHASE I INSTALLATION RESTORATION PROGRAM
DECISION TREE
Complete List of Locations/Sites
Evaluation of Past Operations at Listed Sites
Potential for Contamination
No
Yes
Delete Sites
Potential for Migration
Potential for Other Environmental Concerns
No
No
Yes
Yes
Delete Sites
Refer to Base Environmental Program
List of Sites to be Rated
Consolidate Specific Site Data
Apply AF Hazard Rating Methodology
Numerical Site Rating
Conclusions
Recommendations
USAF Review of Report Recommendations
No Further Action
Initiate Phase II Action

base interviews the applicable federal, state and local agencies were contacted for pertinent Duluth IAP related environmental data. These agencies included:

- U.S. Geological Survey, Water Resources Division (Minneapolis)
- Minnesota Geological Survey (Minneapolis)
- Minnesota Soil and Water Conservation Board (Minneapolis)
- Minnesota Pollution Control Agency (Minneapolis and Duluth)

The next step in the activity review was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous wastes from the various operations on the base. Included in this part of the activities review was the identification of all known past landfill sites and burial sites; as well as any other possible sources of contamination such as fuel-saturated areas resulting from large fuel spills. A general ground tour of identified sites was then made by the ES Project Team to gather site specific information including (1) visual evidence of environmental stress, (2) the presence of nearby drainage ditches or surface-water bodies, and (3) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential exists for hazardous waste contamination in any of the identified sites. If not, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for contaminant migration was made by considering site-specific soil and ground-water conditions. If there was potential for on-base contamination or other environmental concerns the site was referred to the base environmental program for further action. If the potential for contamination migration was considered significant, then the site was evaluated and prioritized using the site rating methodology (Appendix G).

The site rating indicates the relative potential environmental impact for contaminant migration at each site. For those sites showing a high potential, recommendations are made to verify and quantify the potential contaminant migration problem under Phase II of the Installation Restoration Program. For those sites showing a moderate potential, a limited Phase II program may be recommended to confirm that a contaminant migration problem does or does not exist. For those sites showing a lower potential, no further follow-up Phase II work would be recommended.

SECTION 2

INSTALLATION DESCRIPTION

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE, AND BOUNDARIES

The Duluth International Airport (IAP) is located in St. Louis County in northeastern Minnesota, approximately seven miles northwest of the City of Duluth and the western end of Lake Superior (Figures 2.1 and 2.2). A site plan is presented in Figure 2.3. Duluth IAP is operated jointly by the Air Force, Air National Guard, and the City of Duluth. The airport encompasses 1,995 acres. Facilities available for Air Force use include six miles of paved roads, three miles of unimproved gravel roads, approximately one million square feet of technical and administrative space, quarters for over 700 single officers and airmen, and 345 family housing units. The base includes approximately 100 buildings, exclusive of housing. The City of Duluth owns the 10,150 ft. by 150 ft. runway, which is utilized by the Air Force, Air National Guard, and civilian aircraft. Approximately 72,350 square yards of taxiways and 38,360 square yards of aprons are owned by the Air Force.

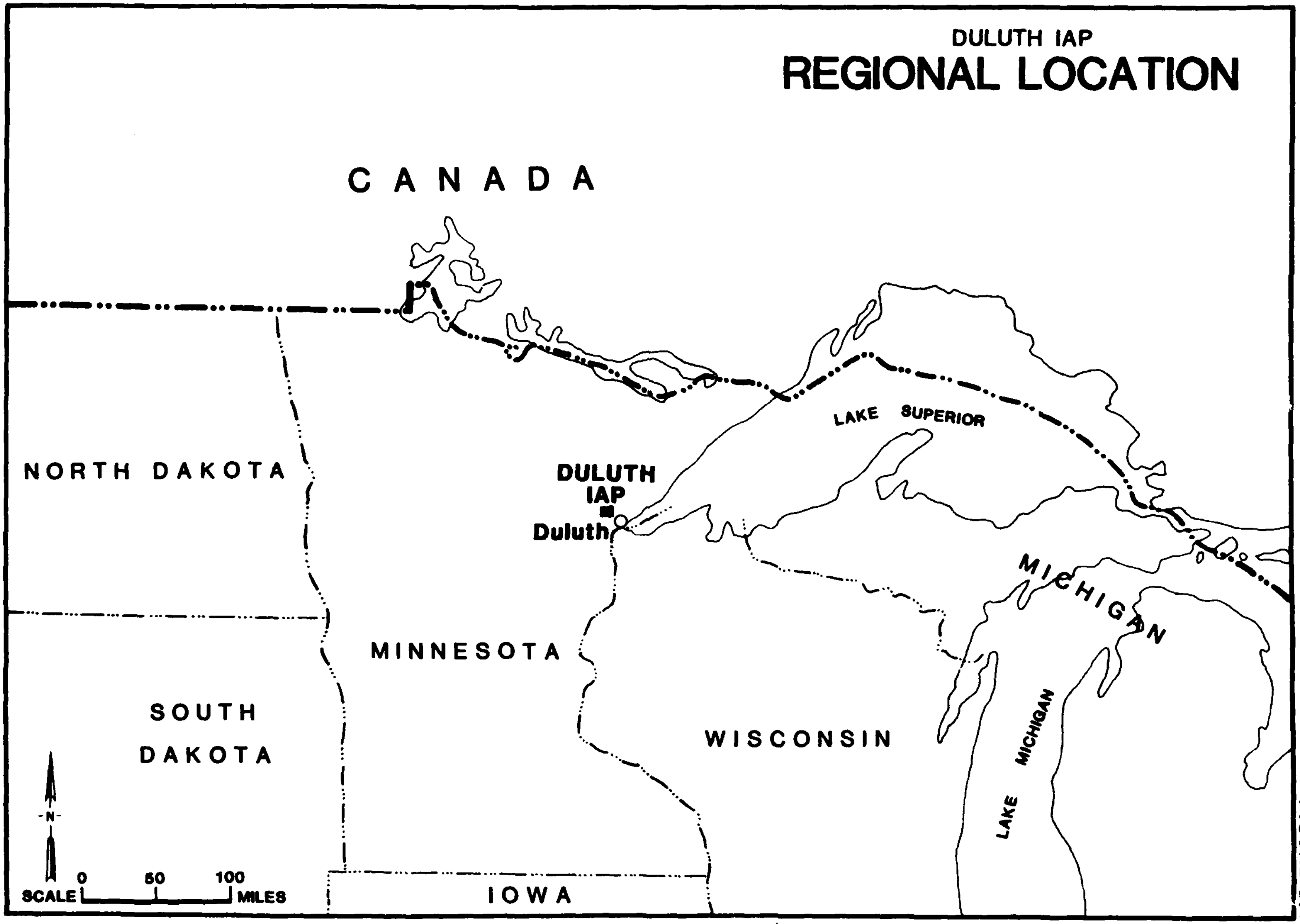
Of the 345 total family housing units available to USAF personnel, 105 are located on base, and 240 are located in the Capehart military housing area located approximately three miles east of the base. The housing area is included in this Phase I study.

Disposal sites on the properties owned by the Air National Guard and the City of Duluth are not included in this study. However, past waste disposal activities by the Air National Guard or the City of Duluth on Air Force or joint use lands are included.

ORGANIZATION AND MISSION

Duluth International Airport was originally known as Williamson-Johnson Airport. From 1948 to 1951, the airport was used by the 133rd Fighter Group of the Minnesota Air National Guard (ANG).

FIGURE 2.1



ES ENGINEERING-SCIENCE

FIGURE 2.2

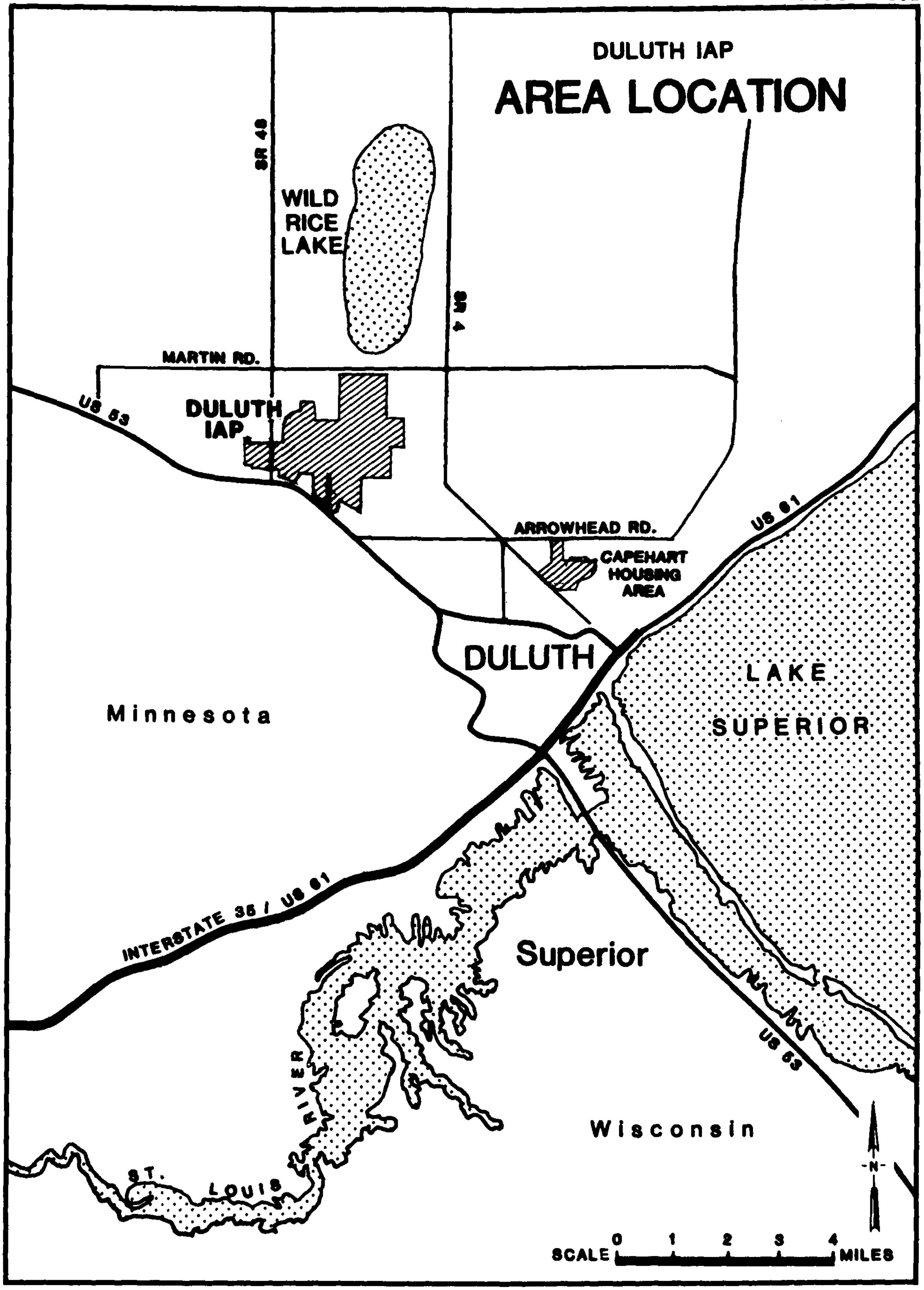
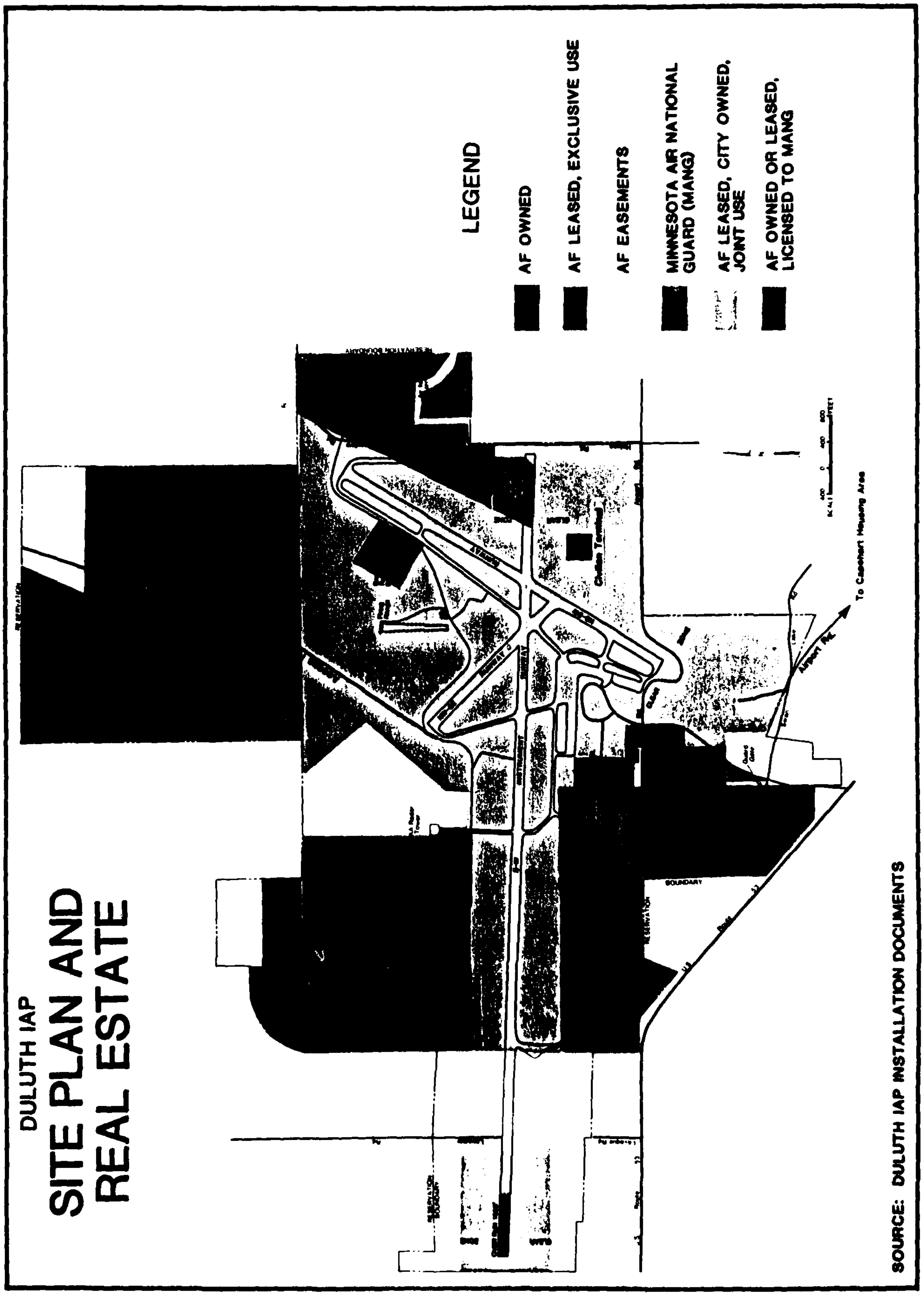

DULUTH IAP
AREA LOCATION
SR 48
WILD RICE LAKE
SR 4
MARTIN RD.
US 53
DULUTH IAP
ARROWHEAD RD.
CAPEHART HOUSING AREA
US 61
DULUTH
LAKE SUPERIOR
Minnesota
INTERSTATE 35 / US 61
Superior
US 53
ST. LOUIS RIVER
Wisconsin
N
SCALE 0 1 2 3 4 MILES

FIGURE 2.3


DULUTH IAP
SITE PLAN AND
REAL ESTATE
LEGEND
AF OWNED
AF LEASED, EXCLUSIVE USE
AF EASEMENTS
MINNESOTA AIR NATIONAL GUARD (MANG)
AF LEASED, CITY OWNED, JOINT USE
AF OWNED OR LEASED, LICENSED TO MANG
RESERVATION BOUNDARY
Airport Rd.
To Capehart Housing Area
SOURCE: DUWTH IAP INSTALLATION DOCUMENTS

During 1952 the ANG was returned to the state and the airport was named Duluth Municipal airport. The Duluth Air Defense sector was declared operational on November 15, 1959 and given the responsibility of patrolling 70,000 square miles of the United States and Canadian territory. In 1963 the airport was renamed Duluth International Airport. The facility continued to be utilized by the Air Force, Air National Guard and the City of Duluth.

The mission of the 4787th Air Base Group, Duluth IAP until September 30, 1981 was to support the 23rd North American Aerospace Defense Command (NORAD) Region/Air Division and other Air Force tenant organizations. The 23rd NORAD Region/Air Division ceased operations on September 30, 1981 and was inactivated on December 31, 1981. The closure of Duluth IAP was announced on October 16, 1981 and by October 1, 1982 there will only be about 38 DOD employees remaining. The 148th Tactical Reconnaissance Group (Minnesota Air National Guard) will continue its operations indefinitely.

SECTION 3

ENVIRONMENTAL SETTING

SECTION 3
ENVIRONMENTAL SETTING

The environmental setting of Duluth International Airport (IAP) is described in this section with the primary emphasis directed toward identifying features that may facilitate the movement of hazardous waste contaminants. Environmental conditions pertinent to this study are highlighted at the end of this section.

METEOROLOGY

Temperature, precipitation, snowfall and other relevant climatic data furnished by the National Oceanographic and Atmospheric Administration Environmental Data and Information Service (1981) are presented as Table 3.1. The summarized data indicate that mean annual precipitation is 30.18 inches and that mean annual snowfall is 76.7 inches. Lindholm et al (1979) report that based upon a St. Louis County average of 27.5 inches precipitation, direct runoff equals 9.7 inches and that evapotranspiration is 17.8 inches. The summarized data indicate that net annual precipitation is 10 inches.

GEOGRAPHY

The Duluth area lies within the North Shore Highland section of the Superior Upland, a submaturely dissected, recently glaciated penaplain overlying complexly structure crystalline rocks (Fenneman, 1938). The regional land surface typically appears flat to gently rolling. Low areas have developed swamps and bogs due to perenially wet conditions and generally poor area drainage.

Topography

Regional elevations of the North Shore Highland generally range from 900 feet MSL overlooking Lake Superior west of Duluth, to 1500 feet

TABLE 3.1
CLIMATIC DATA FOR DULUTH IAP

Month	Temperature Mean Max (°F)	Temperature Mean Min (°F)	Rainfall Mean (in)	Rainfall Max (in)	Snowfall Mean (in)	Snowfall Max (in)	Wind Mean Speed (mph)	Wind Prevailing Direction
Jan	16.9	-0.5	1.13	4.70	17.0	46.8	11.8	NW
Feb	21.2	3.0	0.96	2.37	12.1	31.5	11.5	NW
Mar	32.3	15.6	1.68	5.12	14.0	45.5	11.9	WNW
Apr	46.8	29.3	2.13	5.84	6.5	31.5	12.9	NW
May	59.1	39.1	3.10	7.67	0.9	8.1	12.0	E
June	68.9	48.1	3.95	7.51	T	0.2	10.7	E
July	75.4	54.9	3.74	8.48	0.0	0.0	9.7	WNW
Aug	73.2	54.1	3.51	10.31	T	T	9.7	E
Sept	64.1	46.1	3.21	6.61	T	0.0	10.6	WNW
Oct	52.7	36.2	2.19	7.53	1.1	8.1	11.3	WNW
Nov	35.6	21.9	1.63	4.19	9.8	28.9	11.9	WNW
Dec	22.4	7.1	1.13	3.70	15.3	44.3	11.4	NW
Annual	47.4	29.6	28.36	10.31	76.7	46.8	11.3	WNW

Period of record: 1941-1970 normal
1941-1980 extremes

Source: National Oceanographic and Atmospheric Administration, 1980.

MSL at the Canadian border. Area relief is the result of glacial activity during the last (Wisconsin) period of major glaciation which has covered area bedrock with a relatively thin veneer of glacial drift. Locally, relief may be very distinct due to the presence of deposits of unconsolidated materials in the form of such glacial landforms as karnes (irregular, rounded, sometimes dome-like hillocks of stratified drift), kettles (depressions in the topographic surface, that are caused by melting pockets of glacial ice which may fill with water, forming ponds) and moraines (accumulations of glacial till pushed up by the glacier).

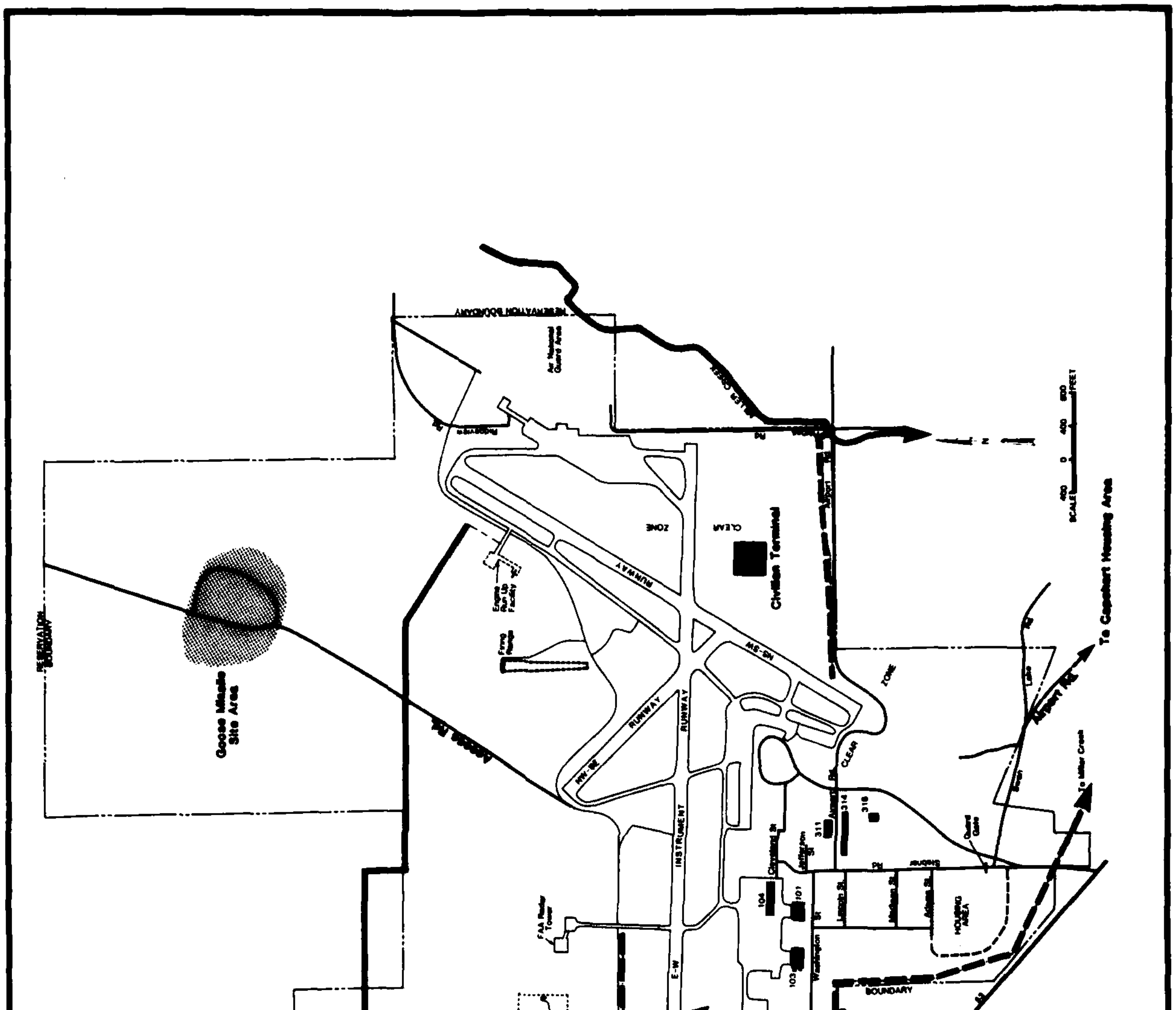
Surface elevations at Duluth IAP vary from 1400 feet MSL along the south installation boundary to 1428 feet MSL near the SAGE building.

Drainage

The study area is principally drained by two streams, Miller Creek and Beaver Creek. Miller Creek originates at a point approximately one mile northeast of Duluth IAP in the vicinity of the existing municipal landfill. Its direction of flow is generally south and it receives intermittent drainage from the installation through two tributaries. According to Musick (1982), the course of Miller Creek has been altered in the vicinity of the municipal landfill in order to preclude water quality degradation due to landfill leachate interception. Beaver Creek originates on the northwest gradient of the base and flows along in generally northward course towards Wild Rice Lake Reservoir. Beaver Creek receives intermittent drainage from the base through three tributaries. Figure 3.1 depicts installation drainage features.

Surface Soils

Surface soils of the installation area have been mapped by the USDA, Soil Conservation Service (1981). A significant portion of the base land area is mapped as "Modified or Urban Land." Soils of this unit have been altered, completely removed locally or have been buried as a result of base construction or individual site use modification projects. This unit typically overlies low to moderately permeable glacial soils that may exert severe constraints over the development of waste disposal facilities due to normally high water tables. Of the eleven remaining soil units identified on base, all probably restrict waste disposal practices due to material permeabilities, perenially high


DULUTH IAP
DRAINAGE
Goose Missile Site Area
Civilian Terminal
BEAVER CREEK
To Capehart Housing Area
LEGEND
PERENNIAL STREAM
INTERMITTENT STREAM
DIRECTION OF FLOW
SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

water tables (usually within six feet of ground surface) or flooding potential. Five of the identified soil units are characteristic of a wetland environment. Base soils data are summarized on Table 3.2 and soil units are presented in Figure 3.2.

GEOLOGY

The geology of the Duluth area has been reported by several investigators, including Sims and Morey, Green, Phinney and Bonnichsen (all 1972) and has been mapped by Sims (1970). A brief review of their work was performed in support of this investigation.

Consolidated Unit

The consolidated rocks underlying Duluth IAP are Upper PreCambrian age anorthositic, troctolitic, grabbroic, granodioritic and granitic intrinsive (igneous) materials collectively assigned to the Duluth Complex. The Duluth Complex occurs in an arcuate pattern extending from the City of Duluth northward some 150 miles to the Canadian border, with a surface area of approximately 2500 square miles. The unit may have originated as one large mass of magma which developed into a sublayered, somewhat differentiated rock sequence through internal convective movements (Phinney, 1972). The maximum thickness of the Duluth Complex may approach 16,000 feet; unit dip in a southerly direction varies from 15 to 20 degrees. No faults have been mapped in this unit in the Duluth IAP area.

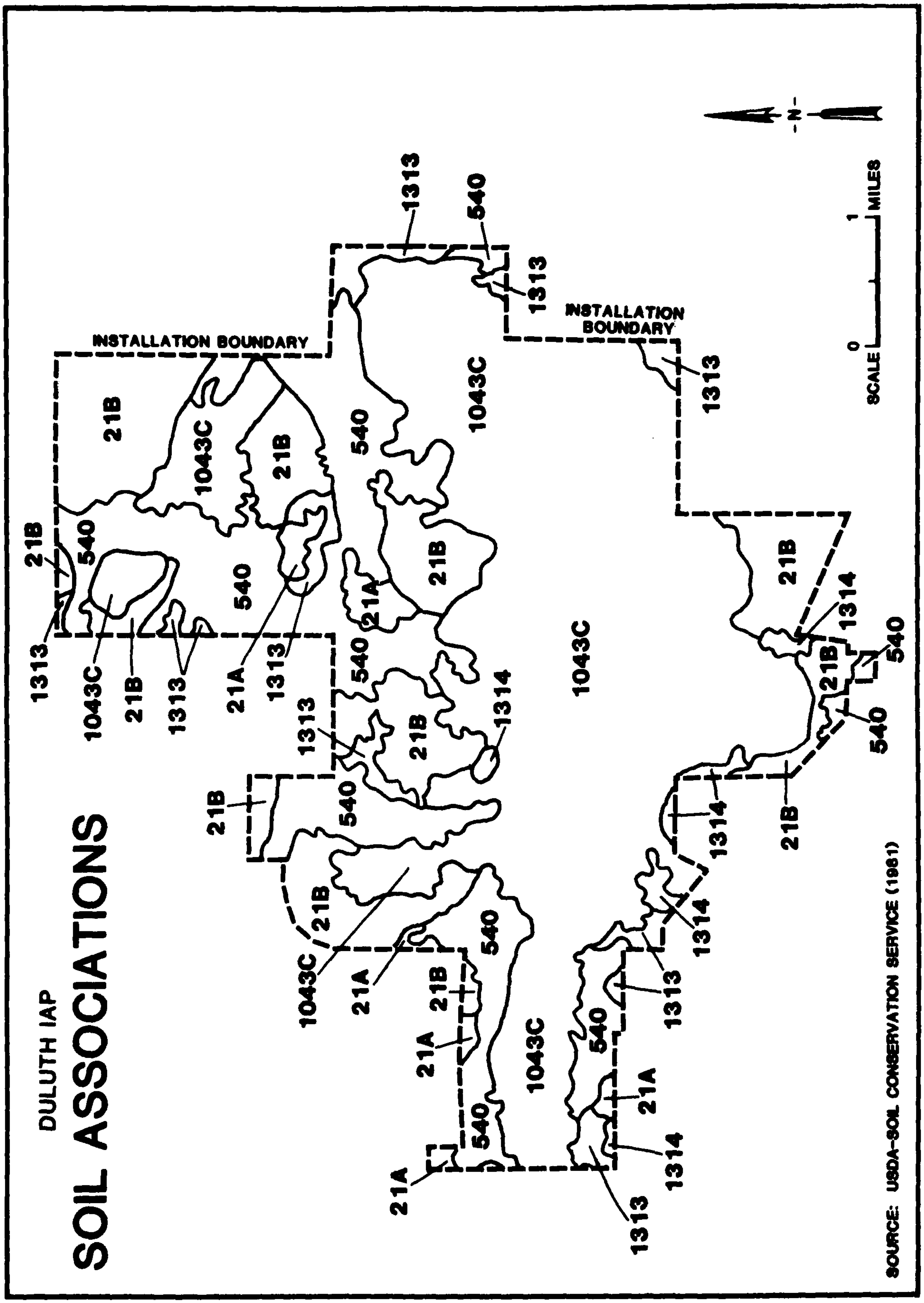
Unconsolidated Unit

The only significant unconsolidated unit is represented in the study area by Pleistocene age glacial drift. These materials, consisting of a heterogeneous mixture of cobbles, gravel, sand, silt and clay, were deposited during the last major period of glaciation (Wisconsin). The drift forms a relatively level, thin mantle overlying the older consolidated Duluth Complex, and is known to vary in thickness at the base from 10 to 60 feet (Tab A-1, Section 3.1.2.1). Numerous poorly drained low areas have facilitated the development of swamps and peat bogs on the drift surface locally. The lithology of the unconsolidated glacial materials is graphically depicted as Figures 3.3 and 3.4, the logs of two representative installation construction (foundation) test borings.

TABLE 3.2
DULUTH IAP SOIL UNITS

Map Symbol	Name	Slope per cent	USDA Texture (major fraction)	Thickness (inches)	Unified Class. (major fraction)	Permeability (Inches/hour)	Disposal Site Use (constraints)
21	Ahmeek	0-3	Fine sandy loam	75	ML,SM	0.2-2.0	Slight
21B	Ahmeek	3-8	Fine sandy loam	75	ML,SM	0.2-2.0	Moderate-slope
21C	Ahmeek	8-18	Fine sandy loam	75	ML,SM	0.2-2.0	Severe-slope
420	Twig muck	level	Muck-silt, loam	72	PT,OL,CL,ML,SM	<0.06-6.0	Severe-wetland
534	Mooselake mucky peat	level	Muck, peat	72	PT	2.0-6.0	Severe-wetland
540	Seeleyville muck	level	Muck, peat	60	PT	0.2-6.0	Severe-wetland
544	Cathro muck	level	Peat, silt loam,loam	60	PT,SM,ML,SC,CL	0.2-6.0	Severe-wetland
1029	Pits, gravel	varies	Surface soils have been removed to expose underlying gravels and sands.				Severe-Permeability
1043C	Modified or Urban land	level	This unit incorporates several soils which have been modified.				Probably severe
1313	Unnamed (Hermantown)	0-2	Fine sandy loam, loam	61	SM,ML	0.2-6.0	Severe-high water table
1314	Cathro and Seeleyville muck (undifferentiated)	level	Refer to individual references above				Severe-wetland
1072	Udorthents	varies	Loamy soils, shallow over garbage	24-48	CL,GC (highly variable)	Not estimated	------------------

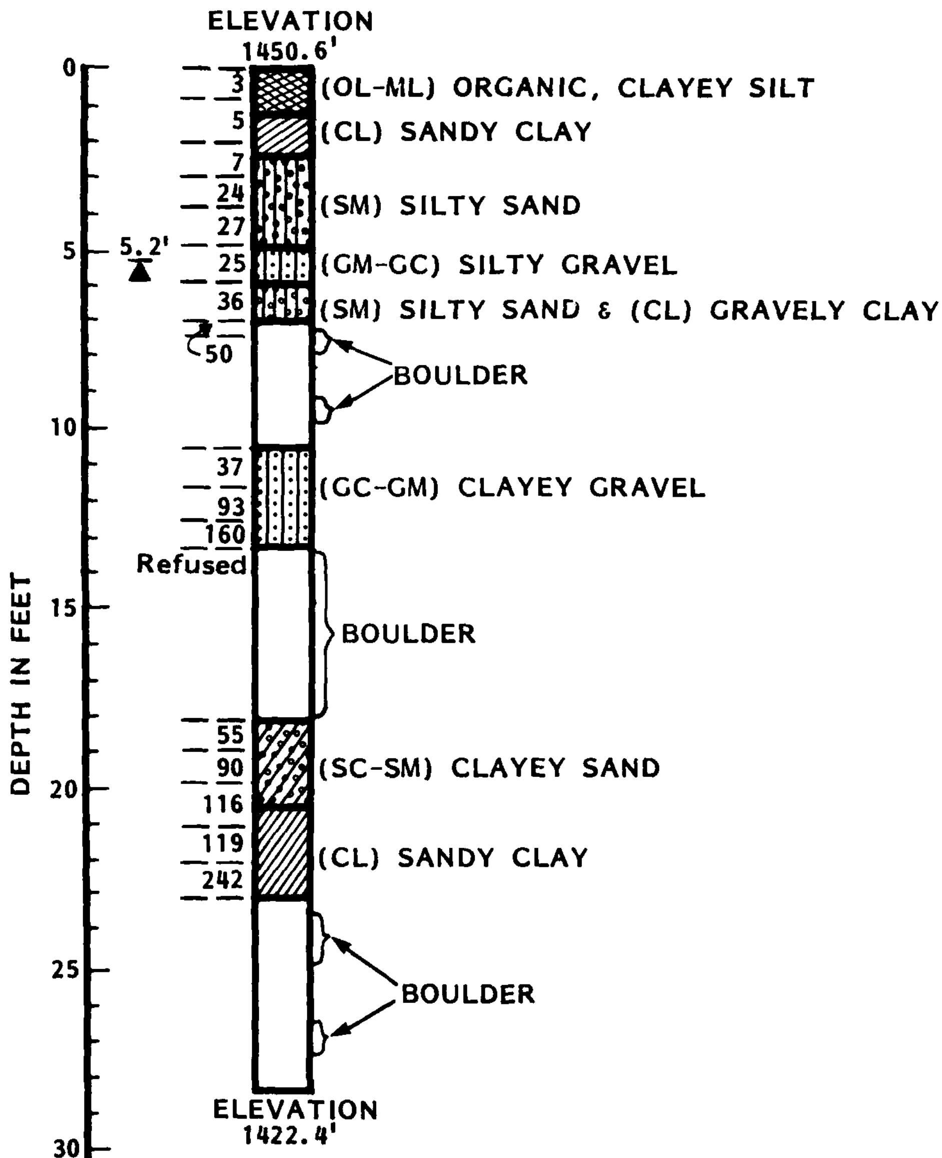
Source: USDA, Soil Conservation Service (1981)


DULUTH IAP
SOIL ASSOCIATIONS
INSTALLATION BOUNDARY
INSTALLATION BOUNDARY
21A
21B
540
1043C
1313
1314
SCALE
0
1
MILES
N
SOURCE: USDA-SOIL CONSERVATION SERVICE (1961)

DULUTH IAP

LOG OF TEST BORING

AFD 526
27-28 June, 1962



STA 96 + 00 ℄

NOTE:
Numbers to the left of the column represent the Standard Penetration Test.

The water table is at 5.2 feet.

SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

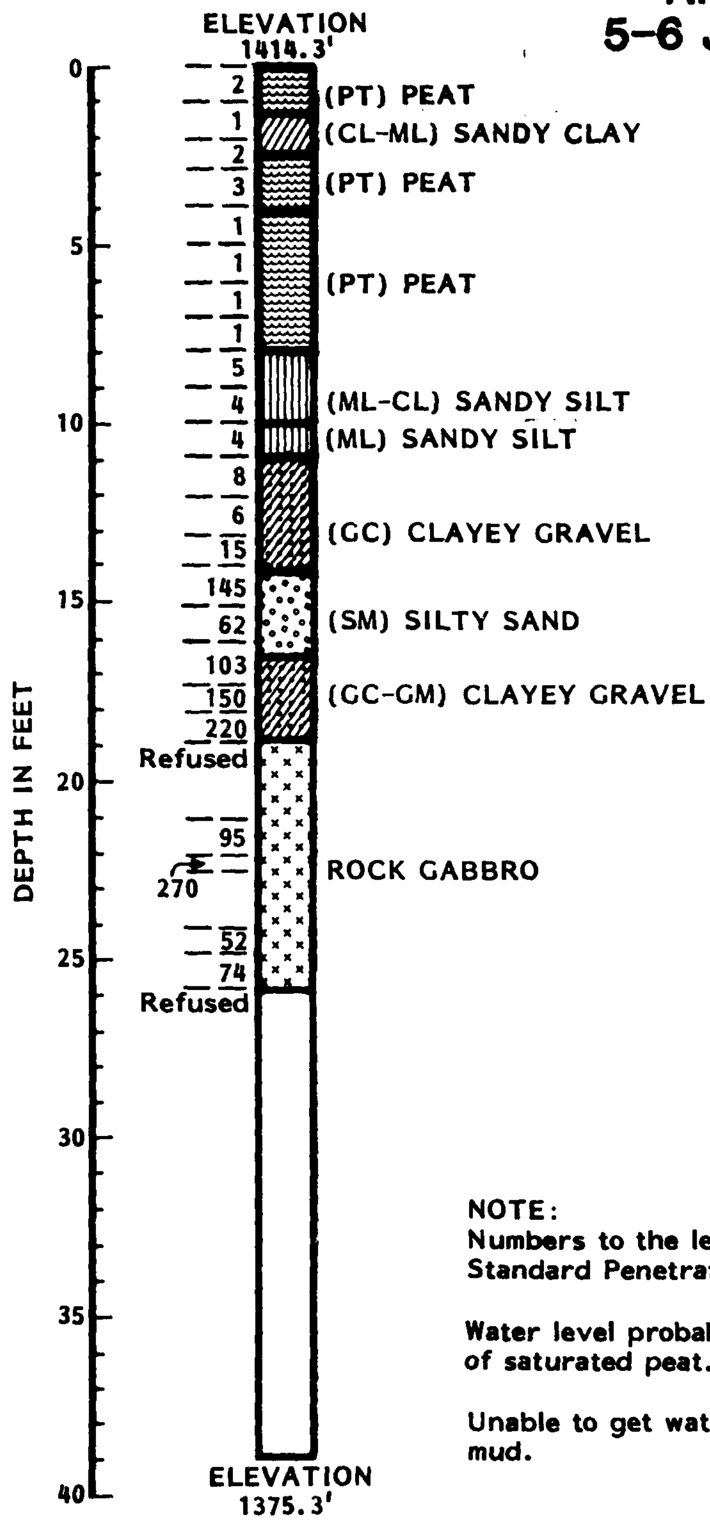
FIGURE 3.4

DULUTH IAP

LOG OF TEST BORING

AFD 569

5-6 July, 1962



500'S ℄ R/W STA 58 + 50

NOTE:
Numbers to the left of the column represent Standard Penetration Test.

Water level probably at or near surface of saturated peat.

Unable to get water level prior to using mud.

SOURCE:
DULUTH IAP INSTALLATION DOCUMENTS

ES ENGINEERING-SCIENCE

HYDROLOGY

Introduction

Ground water hydrology of the Duluth-St. Louis County area has been reported by Hogberg (1972), Weist (1978), Olcott et al (1978), Lindholm et al (1979) and Kanivetsky (1978, 1979). Additional information has been obtained from McSwinney (1982).

Duluth IAP lies within the East-Central ground-water province of Minnesota. Ground water resources of the region are typically derived from unconsolidated glacial sediments or underlying rock aquifers. The major source of recharge to local aquifers consists of precipitation falling directly on the unsaturated portion of the aquifer, or percolation through a communicating unit in contact with the aquifer.

Most of the Duluth IAP area appears to lie within a ground-water discharge zone. This is supported by typically high soil unit water levels, perennial streamflow on and adjacent to the base and the presence of numerous large permanent wetlands on and adjacent to the installation.

Hydrogeologic Units

Two distinct hydrogeologic units have been identified at the base, which directly corresponds to the previously discussed geologic units: Consolidated rock aquifer and the glacial drift aquifer. A brief review of the hydrologic characteristics of each unit follows:

1. Glacial drift. This unit consists of glacially deposited, heterogeneous mixtures of sand, silt, clay, gravel, cobbles, etc., unstratified and locally very compact. As noted previously, the unit varies in thickness from 10 to 60 feet at the base, directly overlying and in hydraulic communication with the consolidated rock aquifer below. Ground water occurs in this unit under water table (unconfined) conditions. According to Lindholm et al (1979) in a survey of St. Louis River Watershed Water Resources, wells dug or drilled into the drift aquifer encounter ground water at depths ranging from 3 to 25 feet below ground surface. Such wells are usually constructed at depths of 15 to 80 feet and tend to yield adequate supplies for domestic consumption (5-25 gallons per minute yield). This is the most productive area aquifer. Lindholm et al (1979) further report that water in this aquifer is of good quality.

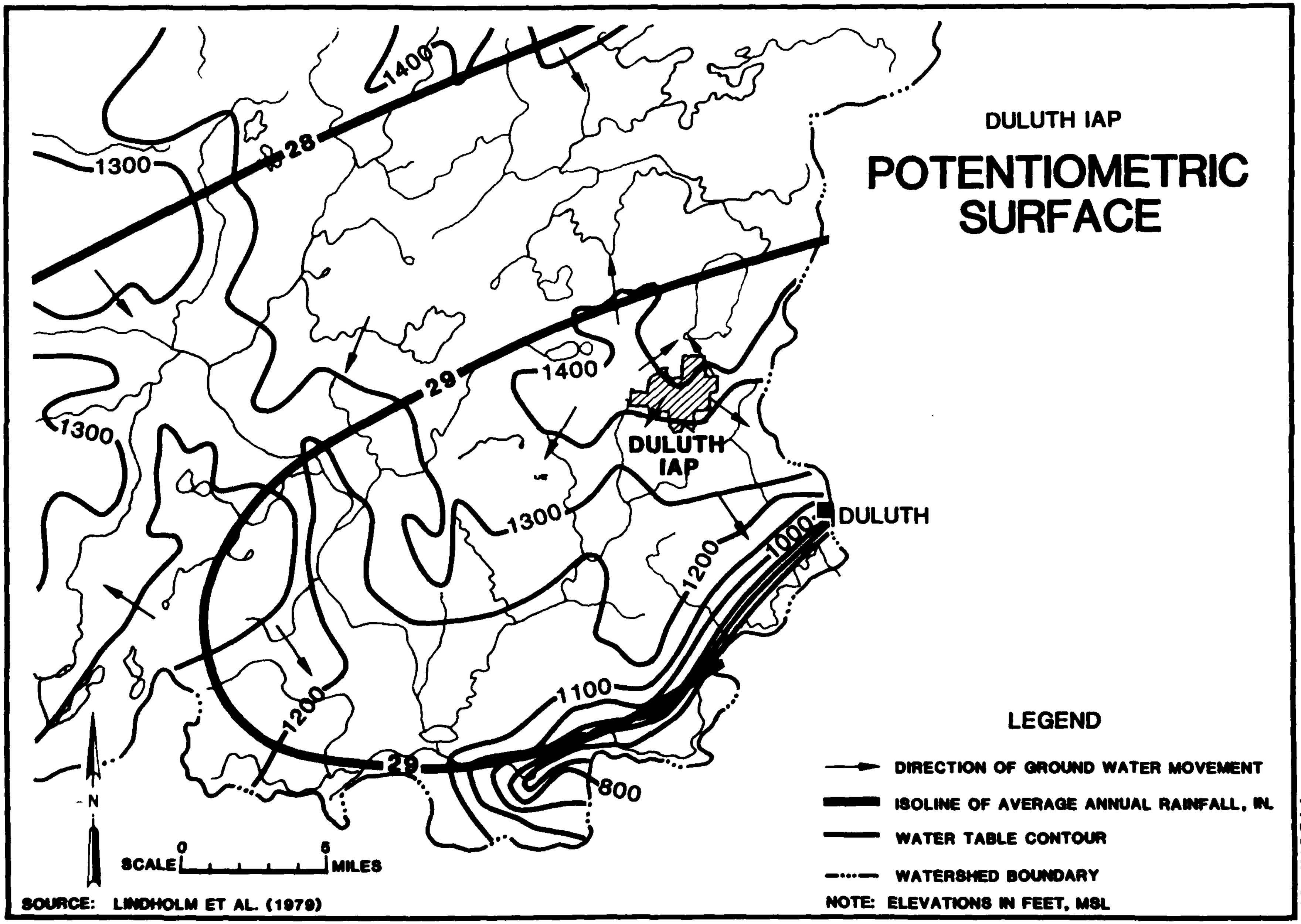
2. Consolidated rock (Gabbro) aquifer. Immediately below the drift is the consolidated rock aquifer, comprised of the previously cited Duluth Complex rocks. Water is contained in this unit in fractures, fissures, interstices and other secondary openings under generally water table (unconfined) conditions. Rock aquifer wells drilled to depths of 100 to 700 feet usually encounter ground water 10 to 30 feet below ground surface. The consolidated rock aquifer and the overlying glacial drift aquifer are apparently in hydraulic communication, as water levels observed in both units are essentially similar. Observed yields are poor, usually on the order of five gallons per minute or less. Typically, wells completed in bedrock have long "open hole" sections (uncased); the open hole section is intended to function as a reservoir, thereby improving well reliability and yield. Lindholm et al (1979) states that the quality of water is generally good.

Duluth IAP and adjacent communities utilize City of Duluth water supplies which are drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small-capacity glacial drift wells. A single bedrock well, drilled to a depth of 497 feet was constructed on the installation. Well construction information was not available for review; the well has not been in use for several years as it has not yielded sufficient water for public water supplies.

Ground-water flow directions are indicated on Figure 3.5, which has been modified from regional data (Lindholm et al, 1979). It is suspected that a ground-water divide exists paralleling the main runway. Ground-water flow north of the runway flows northward toward the Wild Rice Lake, while ground water south of the runway flows south. The suspected ground-water divide has been mapped by Lindholm et al (1979) and corresponds to a surface water divide identified by Musick (1982).

SURFACE WATER QUALITY

The Minnesota Pollution Control Agency has primary regulatory responsiblity for water quality and the State of Minnesota. Regulations


DULUTH IAP
POTENTIOMETRIC SURFACE
1400
28
1300
29
1400
1300
DULUTH IAP
DULUTH
1300
1200
1000
1200
1100
29
800
N
SCALE 0 5 MILES
LEGEND
DIRECTION OF GROUND WATER MOVEMENT
ISOLINE OF AVERAGE ANNUAL RAINFALL, IN.
WATER TABLE CONTOUR
WATERSHED BOUNDARY
NOTE: ELEVATIONS IN FEET, MSL
SOURCE: LINDHOLM ET AL. (1979)

WPC 1 through WPC 41 of the Minnesota Code of Agency Rules, Pollution Control Agency, Division of Water Quality, establish the rules, regulations, classifications, and standards for State waters. Under Regulations WPC 24 and WPC 25, all intrastate and interstate waters of the State of Minnesota are grouped into one or more of the following water use classifications:

(1) Domestic Consumption
(2) Fisheries and Recreation
(3) Industrial Consumption
(4) Agriculture and Wildlife
(5) Navigation and Waste Disposal
(6) Other Uses

Under each water use classification, water quality standards are subdivided into classes applying to various surface waters throughout the State.

Surface waters at Duluth IAP drain into the two watersheds. The southern and eastern portions of the base drain into Miller Creek, which in turn drains into the St. Louis River and ultimately to Lake Superior. Miller Creek is classified as suitable for the following water uses: 1) domestic consumption; 2) the propagation and maintenance of warm or cold water sport or commercial fishes, as well as aquatic recreation; 3) general industrial purposes, except for food processing; 4) irrigation and use by agriculture or wildlife; and 5) navigation and waste disposal.

The western and northern sections of the base drain north through a small tributary, sometimes known as Beaver Creek. This tributary drains into Rice Lake, a tributary of the Cloquet River which empties into the St. Louis River and Lake Superior. With the exception of domestic consumption, the same designated water uses for Miller Creek apply to Beaver Creek. Stream standards for both Miller Creek and Beaver Creek are illustrated in Appendix C.

The drainage from the Capehart military housing area, located approximately 3 miles east of the base, flows into two tributaries which join to form Chester Creek. The creek ultimately empties into Lake Superior. Designated water uses and water quality standards for Chester Creek are the same as Miller Creek.

Water Quality Monitoring

A total of nine water quality monitoring stations are maintained by Air Force personnel at Duluth IAP for the purpose of determining the impact of Air Force activities on the environment. Five stations are located in the vicinity of the airport, and four are located in the Capehart military housing area. Two stations are maintained for monitoring sanitary sewage leaving the main base and Capehart housing area, while the other seven are used to monitor surface water quality. The monitoring station locations are shown in Figure 3.6 and are summarized in Table 3.3.

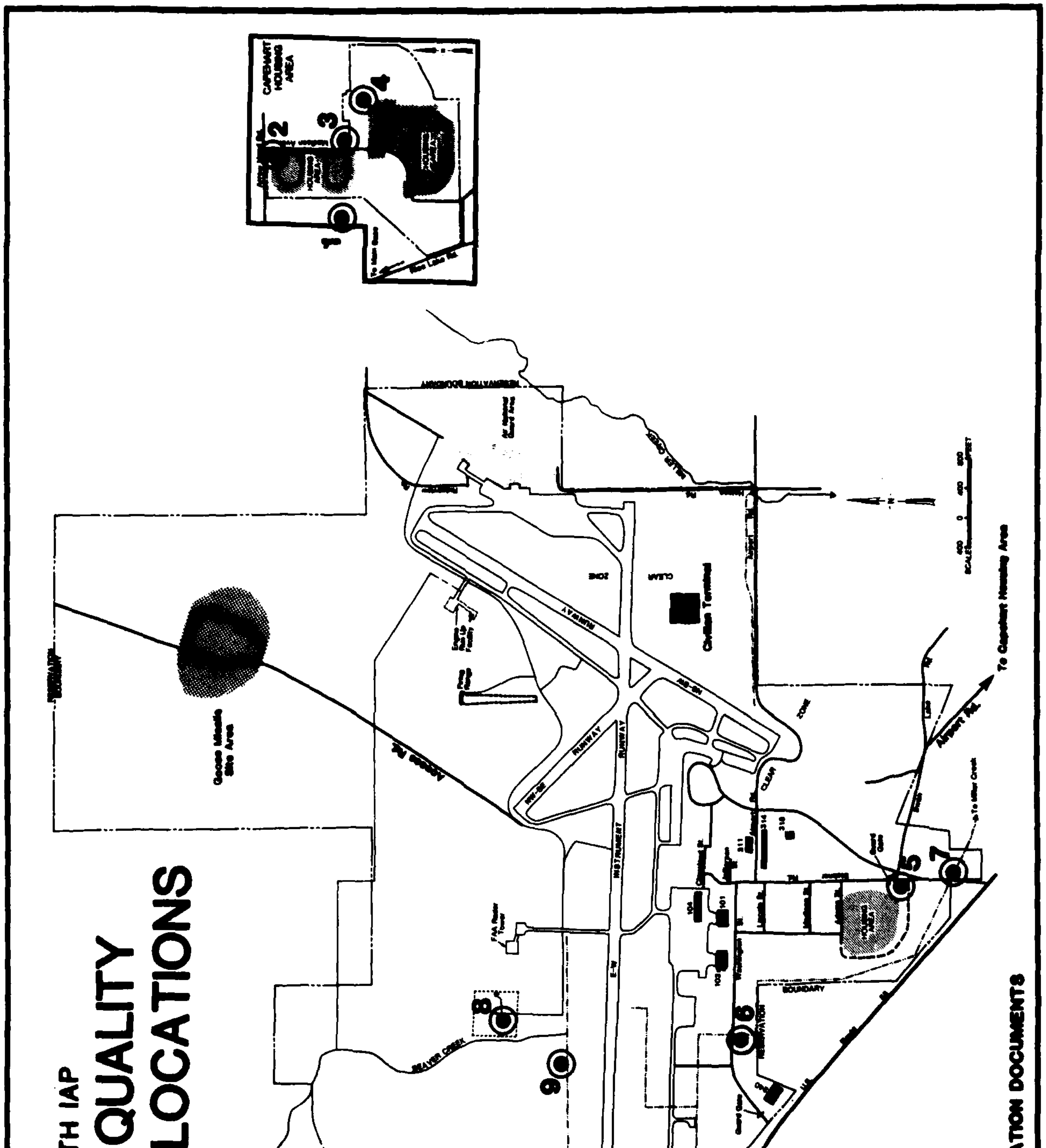
Water quality data has been collected at each site periodically since 1975. These data were compared to the surface water quality standards applicable to each water body. It is difficult to make specific conclusions about water quality at each station, since limited analyses are available, but some generalizations can be made. A summary of selected parameters for each station is illustrated in Appendix C, Table C.2.

A review of water quality monitoring data for the on-base surface water monitoring stations indicates that ammonia, manganese, iron, copper, and color levels at stations 6, 7, 8, and 9 typically exceed water quality standards. Manganese concentrations as high as 8.44 mg/l have been detected at station 7, far above the water quality standard of 0.05 mg/l for untreated water used for domestic consumption. Slightly elevated phenol concentrations have been observed on occasion at stations 6, 7, and 9. Elevated oil and grease concentrations have been observed at stations 7 and 9, indicating possible impact by base activities.

Stations 6 and 7 are both located on a tributary of Miller Creek: station 6 where the tributary enters base property and station 7 where the tributary leaves the base and joins Miller Creek. Both sites show elevated levels of color, ammonia, manganese, iron, and copper.

Surface water quality at station 1, 2, and 3 in the Capehart military housing area is generally good, although color levels are slightly

FIGURE 3.6



DULUTH IAP
WATER QUALITY
SAMPLING LOCATIONS

SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

ES ENGINEERING-SCIENCE

Table 3.3

SURFACE WATER QUALITY SAMPLING STATION

STATION NUMBER	LOCATION
1	Upper Chester Creek near Capehart housing
2	Drainage ditch along Madison Ave. near Capehart housing
3	Confluence of drainage ditch and Chester Creek near Capehart housing
4	Sanitary sewer from Capehart housing
5	Base sanitary sewage lift station
6	Miller Creek incoming flow to base
7	Miller Creek outgoing flow from base
8	Beaver Creek near Building 511
9	Runway runoff

high. Manganese and ammonia concentrations are typically high at station 3. Several samples taken in 1975 also showed elevated iron, phenol, and zinc concentrations.

Quarterly samples were collected for pesticide analysis at sample stations 1 through 9 from the spring of 1980 through 1981. Pesticide analyses were below detectable limits at all points except for one sample period during the summer of 1981. Pesticide analyses during the summer of 1981 at stations 1, 3, 6, 7, 8, and 9 indicated diazinon concentrations from 26 μg/l at station 9 to 200 μg/l at station 7 were present. Water quality criteria are not available for diazinon; however, concentrations as low as 30 μg/l may be toxic to some fish species. Concentrations of 2,4-D at stations 6, 7, and 8 were well below the EPA recommended water quality criteria of 100 μg/l. A chlordane concentration of approximately 0.61 mg/l was detected at station 9. Other pesticides analyzed during this particular sample period were below detection limits. All subsequent pesticide analyses at these same sample points were below detection limits.

ENVIRONMENTAL SUMMARY

Geographic, geologic and hydrologic data evaluated for this study indicate the following:

- The primary area aquifer, the glacial drift aquifer, underlies the installation at ground surface. The aquifer is essentially unprotected from potential contamination by surface infiltration; water levels are reported to be shallow (six feet or less).
- The rock aquifer is in close communication with the glacial drift aquifer.
- The base is located in a ground-water discharge zone.
- Duluth IAP and most adjacent communities receive water supplies from municipal sources obtained from Lake Superior. Isolated domestic and agricultural activities derive water resources from local aquifers, principally the glacial drift.

- Domestic wells do exist within one mile of the base.
- Wetlands exist on Duluth IAP.
- The average annual net precipitation rate is 10 inches.

The above points indicate the potential for the migration of contamination to area aquifers due to past waste disposal practices exists. As the base is situated in a ground-water discharge zone, contaminants entering the upper aquifer would probably be discharged to local streams in base flow or to the numerous wetland zones present. The primary environmental concern, therefore, is judged to be to the quality of local surface waters.

SECTION 4

FINDINGS

SECTION 4

FINDINGS

To assess past hazardous waste management at Duluth IAP, current and past activities of waste generation and disposal were reviewed. This section contains a summary of the wastes generated by activity, a description of disposal methods used at Duluth IAP, and an identification and evaluation of disposal sites located on the base.

PAST ACTIVITY REVIEW

To determine past activities on the base that resulted in generation and disposal of hazardous waste, a review was conducted of current and past waste generation and disposal methods. This review consisted of interviews with base employees, a search of files and records, and site inspections.

Potentially hazardous wastes generated on Duluth can be associated with one of the following four activities carried out on base:

- Industrial Operations (Shops) and Laboratories
- Fuels Management (POL)
- Pesticide Utilization
- Fire Control Training

The following discussion addresses only those wastes generated on base which are either hazardous wastes or potentially hazardous wastes. In this discussion a hazardous waste is defined as hazardous by either the Resource Conservation and Recovery Act (RCRA) or Comprehensive Environmental Response Compensation and Liability Act (CERCLA). A potentially hazardous waste is one which was suspected of being hazardous although insufficient data was available to fully characterize the waste.

Industrial Operations (Shops)

Several industrial shops at Duluth AFB generate potentially hazardous wastes as a result of mission support activities. The Bioenvironmental Engineering (BEE) Office provided a listing of industrial shops which was used as a basis for evaluating past waste generation and hazardous material disposal practices. The BEE shops files were examined for information on chemical usage, hazardous waste generation, and disposal practices. Although the files contained very little information prior to the mid-1970's, more complete information was available for the past several years. A master list of active shops by industrial building, previous locations and identification of hazardous wastes generated and disposed is provided in Appendix D, Table D.1.

Those shops that utilize hazardous materials or generate hazardous wastes and pose a potential for ground water or surface water contamination were selected for further investigation and evaluation. On-site interviews were conducted at many industrial shops, including those that generate the largest amounts of hazardous wastes. Several additional shops generating lesser amounts of hazardous wastes were contacted by telephone following the site visit. At the time of the site visit, several shops were closed due to the pending closure of the base. Information on these shops was obtained from shop files and personnel on base familiar with the particular shop's operation. In the interviews, information on hazardous waste materials, waste quantities, and disposal methods were obtained from each shop. For each major hazardous waste, a hazardous waste disposal timeline was prepared from information provided by shop personnel and others familiar with the shop's operation.

A summary of information obtained in the detailed shop review is presented in Table 4.1. Information on past and present shop locations, hazardous wastes generated in the shop, waste quantities, and disposal methods are included. Disposal timelines are also shown for major wastes: the solid line represents confirmed waste disposal practices, and the dotted line indicates assumed practices. Some shops that generate insignificant quantities of hazardous wastes have been eliminated from Table 4.1.

Larger quantities of waste materials were generated by some shops in the past, particularly those associated with flight operations.

TABLE 4.1
DULUTH IAP

INDUSTRIAL OPERATIONS (Shops)

WASTE GENERATIONS

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY*	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1950 1960 1970 1980
MATERIELS SQUADRON (MATS)				
AGE/TIRE SHOP	103	PD-680	25 GALS./MO.	DRUMMED TO DPDO
		LACQUER THINNER	1 GAL./MO.	DRUMMED TO DPDO
		PAINT REMOVER	1 GAL./MO.	DRUMMED TO DPDO
		WASTE OIL AND GREASE	10 GALS./MO.	DRUMMED TO DPDO
		WASTE FUEL	10 GALS./MO.	FIRE TRAINING
FUEL TEST LAB/POL	126	WASTE FUEL, ALCOHOL, PETROLEUM ETHER	10 GALS./MO.	ABOVE GROUND STORAGE TANK, THEN BURNED
		CHROMIC ACID	<5 GALS./MO.	SANITARY SEWER
VEHICLE MAINTENANCE	318	WASTE OIL	100 GALS./MO.	DRUMMED TO CONTRACTOR
		PS-661	10 GALS./MO.	DRUMMED TO DPDO
VEH. MAINT. PAINT SHOP	103	PAINTS, THINNER	<5 GALS./MO.	DRUMMED TO DPDO
VEH. MAINT. BATTERY SHOP	318	BATTERY ACID	5 GALS./MO.	NEUT., THEN TO SAN. SEWER
REFUELING MAINTENANCE	319	WASTE OIL	50 GALS./MO.	OWS, THEN TO DRAINAGE DITCH; OIL TO STORAGE TANK
BATTERY/ELECTRIC SHOP	103	WASTE ACID	<1 GAL./MO.	NEUT., THEN TO SAN. SEWER
		POTASSIUM HYDROXIDE	<1 GAL./MO.	NEUT., THEN TO SAN. SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL
- - - - ESTIMATED TIME-FRAME BY SHOP PERSONNEL

NEUT.: NEUTRALIZED
OWS: OIL/WATER SEPARATOR

PS-661: SOLVENT
PD-680: SOLVENT

*BASED ON CURRENT RATES

TABLE 4.1 CONT'D.
DULUTH IAP

INDUSTRIAL OPERATIONS (Shops)

WASTE GENERATIONS

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY*	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
USAF CLINIC				
MEDICAL X-RAY	216	DEVELOPER	10 GALS./MO.	SANITARY SEWER → TO SILVER RECOVERY
		FIXER	15 GALS./MO.	TO SILVER RECOVERY
DENTAL X-RAY	216	DEVELOPER	5 GALS./MO.	SANITARY SEWER → TO SILVER RECOVERY
		FIXER	5 GALS./MO.	TO SILVER RECOVERY
4787 AIR BASE GROUP (ABG)				
AUTO HOBBY SHOP	315	WASTE OIL	100 GALS./MO.	DRUMMED TO CONTRACTOR
		WASTE SOLVENTS	15 GALS./MO.	DRUMMED TO CONTRACTOR
23rd AIR DIVISION				
CEMIRT	306	DEGREASER	25 GALS./MO.	EVAPORATION
		CARBON REMOVER	10 GALS./MO.	DPDO
		CLEANING COMPOUND	25 GALS./MO.	SANITARY SEWER
SAGE/POWER PRODUCTION	280	WASTE OIL	10 GALS./MO.	TO SUMP, THEN DRUMMED TO DPDO
		WASTE CRANKCASE OIL	50 GALS./MO.	STORAGE TANK & BURNED IN FIRE TRAINING

KEY
———— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL
- - - - - - ESTIMATED TIME-FRAME BY SHOP PERSONNEL

*BASED ON CURRENT RATES

TABLE 4.1 CONT'D.
DULUTH IAP

INDUSTRIAL OPERATIONS (Shops)

WASTE GENERATIONS

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY*	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
CIVIL ENGINEERING				
ENTOMOLOGY	322	PESTICIDE RINSE WATER	50 GALS./MO.	SANITARY SEWER
		RINSED CANS	5 GALS./MO.	LANDFILL
		EXCESS DILUTE PESTICIDES	10 GALS./MO.	SANITARY SEWER
HEATING PLANT	217	WASTE OIL	<5 GALS./MO.	DRUMMED TO DPDO
PAINT SHOP	339	PAINT, THINNERS, SOLVENTS	5 GALS./MO.	DRUMMED TO DPDO
BATTERY/POWER PRODUCTION	326	WASTE ACID	5 GALS./MO.	NEUT., THEN TO SAN. SEWER
		WASTE OIL	5 GALS./MO.	DRUMMED TO DPDO OR FIRE DEPT.
		ANTIFREEZE	5 GALS./MO.	DRUMMED TO DPDO
ROADS AND GROUNDS	103	WASTE OIL	<5 GALS./MO.	DRUMMED TO DPDO

KEY
——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL
- - - - ESTIMATED TIME-FRAME BY SHOP PERSONNEL

*BASED ON CURRENT RATES

Conversations with base and shop personnel indicate that prior to about 1970, when flight operations were more numerous than at present, larger quantities of waste fuels, oils, and solvents were generated on the flight line. Prior to 1965, approximately 350 gallons of waste fuels and oil were generated per month from aircraft maintenance activities in Building 103. This material was drummed and used by the Fire Department for fire control training. About 200 gallons per month of waste solvents were collected, drummed, and sent to DPDO for disposal.

Several shops on base store waste materials in 55-gallon drums until a sufficient quantity has accumulated to warrant disposal. At many shops, wastes are temporarily stored in one or two 55-gallon drums, although several shops have larger numbers of drums for waste materials. Waste oil and solvents from the Auto Hobby Shop are stored in seven barrels at the shop, and are picked up by a contractor (presently Gopher Oil Co.) when the last barrel is being filled, approximately 4 times per year. Waste products (oil, hydraulic fluid, transmission fluid, and solvents) from the Vehicle Maintenance Shop are stored behind the shop in 10 to 15 barrels. The waste materials are turned in to DPDO about 4 times per year.

Fuels Management

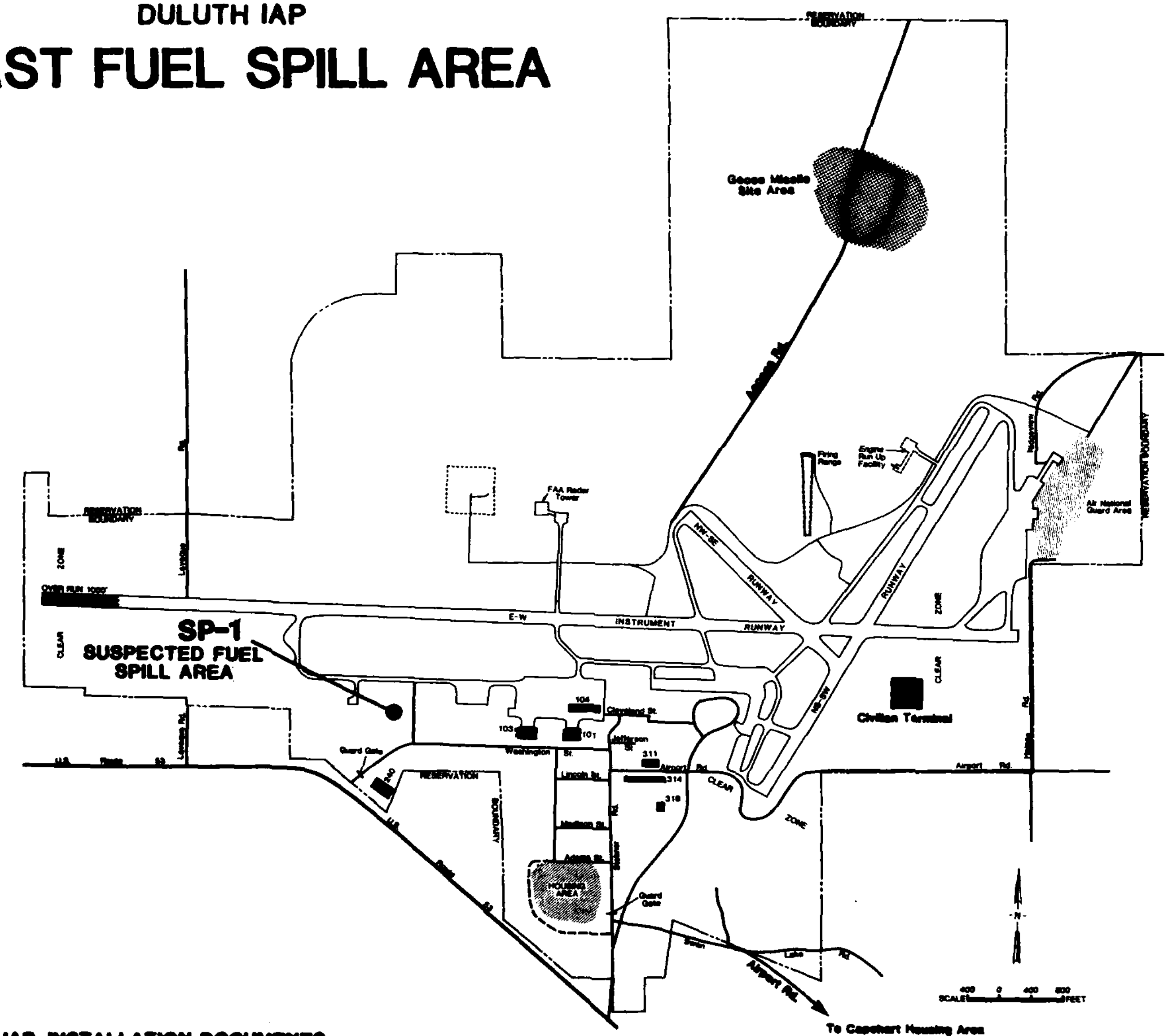
Fuels such as JP-4, Diesel Fuel No. 2, Diesel Fuel No. 1 and MOGAS are utilized and stored at Duluth AFB. The main storage tanks include: 2 - 420,000 gallon above ground JP-4 tanks, 1 - 210,000 above ground JP-4 tank, 2 - 5,000 below ground MOGAS tanks and a 1200 gallon Diesel Fuel No. 1 refueling unit. The complete inventory of fuel storage tanks is located in the Spill Prevention Control and Countermeasures Plan.

Each above ground tank is diked to contain 110 percent of the tank's capacity. Spills are contained in accordance with the Spill Prevention Control and Countermeasures Plan.

A suspected leak was detected in 1980 approximately 150' from tank No. 3 Diesel Fuel No. 2 (Site SP-1). This site is illustrated in Figure 4.1. Oil was observed during repair of a waterline at a depth of 6-7 feet. This leak was observed about 100 feet outside the diked area. Some contaminated soil has been removed from this location and deposited off-site. Site SP-1 presents a potential for contaminant migration.

DULUTH IAP

PAST FUEL SPILL AREA



SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

Spills have occurred in the past but no potential for contaminant migration from these sites currently exists.

The above ground storage tanks have not been cleaned out since 1975. According to past records the Waste POL sludge from storage tank cleanouts would have been disposed off-site by contract disposal.

Miscellaneous fuel spills resulting from loading and unloading vehicles have been caught in drip pans for reuse or if contaminated delivered to Fire Training Site FT-2 for burning in the fire training areas. Approximately 265 gallons are sent to the Fire Department every two months.

Other small storage tanks do exist on base for fuel oils used at such areas as the Capehart Housing Area. No problems have been observed in these areas.

Pesticide Utilization

A variety of herbicides, pesticides, and rodenticides are used at Duluth AFB for controlling weeds, insects, and rodents on base. The base pesticide/herbicide program is handled through the entomology shop in Building 322. A summary of pesticides stored at the entomology shop is presented in Table 4.2.

Spraying equipment consists primarily of small hand-held and back-pack sprayers, although a larger frame-mounted sprayer is used infrequently. After use, spraying equipment is rinsed at the entomology shop. Rinse water is discharged to the sanitary sewer. Shop personnel estimate that approximately 50 gallons per month of rinse water is disposed of in this manner. Small quantities of dilute pesticides (10 gallons per month) remaining in the sprayers are also discharged to the sewer.

Used chemical containers are triple-rinsed with soap and water to remove residual pesticide. The rinse water is discharged to the sanitary sewer. After rinsing, holes are punched in the containers to prevent their reuse, and the containers are disposed of as general refuse. Approximately 40 to 50 used chemical containers are disposed of per year, not including aerosol cans. From 50 to 60 aerosol cans are also disposed of as general refuse.

Table 4.2

CURRENT PESTICIDE INVENTORY

Entomology Shop

INSECTICIDES	HERBICIDES	RODENTICIDES
Carbaryl	Spike	Anticoagulant
Baygon	Pramitol	Diphacin
Pyrethrum	Rhodia, 2,4-D	Warfarom
d-Phenolthrin		
Diazinon		
ABATE	OTHER	
Malathion		
Lindane	Grosley's "No Roost"	

Building 513

Malathion	
ABATE	
Lindane	
Dieldrin	
Diazinon	
Chlordane	

Source: Duluth IAP BEE Files

Old or unused pesticides are presently sent to DPDO for disposal. Previous disposal practices are not known; however, rusted pesticide containers have been identified in several dump sites on base. Several pesticides are presently stored in Building 513. These pesticides are listed in Table 4.2. Current plans are to have the materials removed for contract disposal during 1982. Several barrels and large cans of DDT were stored in Building 513 prior to their removal from the base during November 1981. The DDT was previously stored in Building 147 between 1972 and 1980. No evidence of potential contamination at this site exists.

Pesticides which were detected at several surface water sampling points during one sampling period in June, 1981 are most likely not a result of past disposal sites since no disposal sites exist in these areas. Pesticides were not detected at these same surface water sampling points during subsequent sampling.

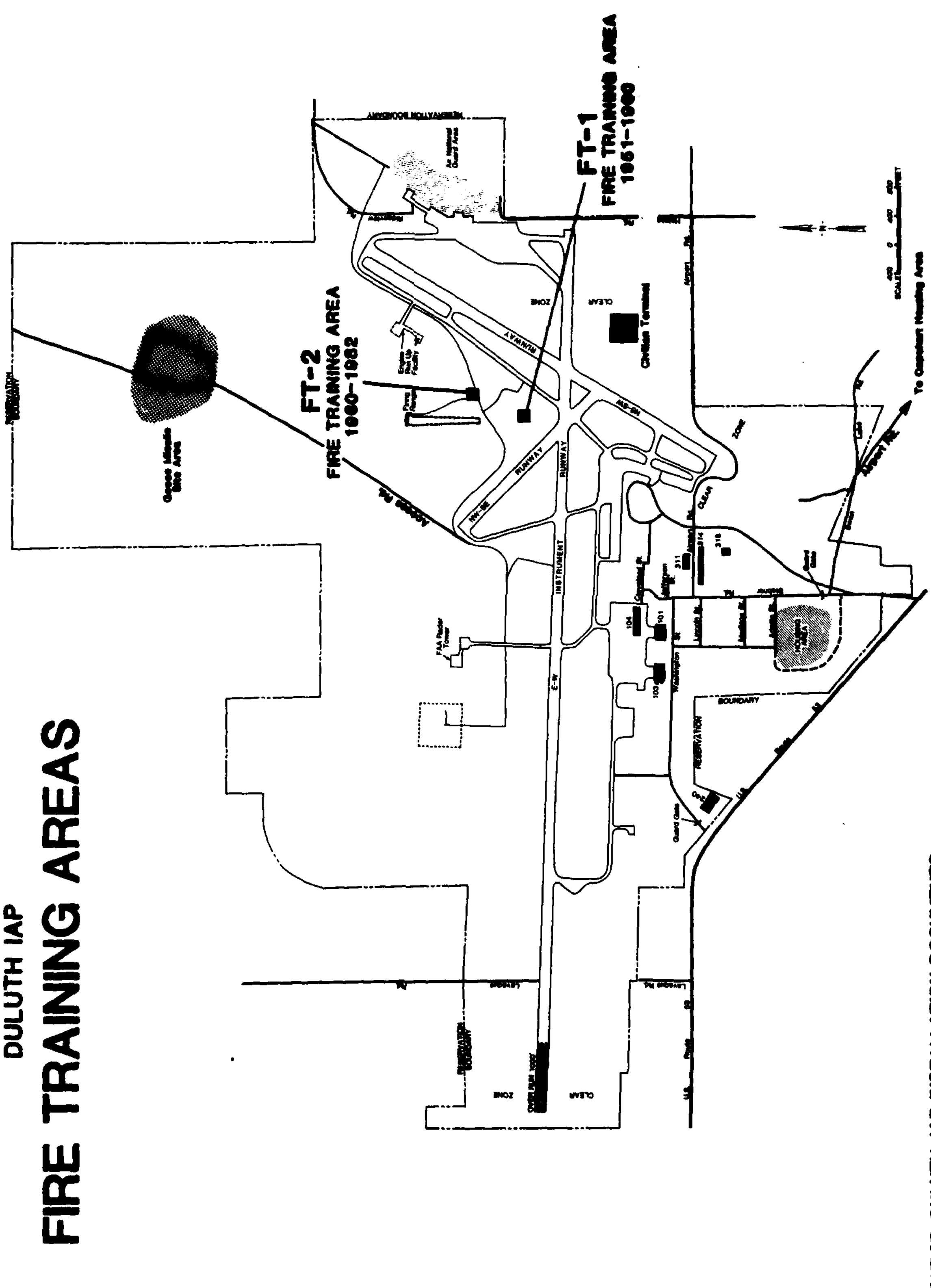
Fire Training Areas

Fire Training (FT) activities have been conducted by the Fire Department at two locations on Duluth AFB, as shown on Figure 4.2. Both areas are located north of the main runway, in the V-shape formed by the two smaller runways. Early FT activities were conducted in the area designated FT-1 south of the access road. Present FT activities are conducted north of the access road in the area designated as FT-2 on Figure 4.2.

Prior to the early 1960's, FT activities were conducted in two excavated pits (FT-1) located on high ground between FT-2 and the main runway. The pits were approximately 40 feet wide, 50 feet long, and 3 to 4 feet in depth, and contained about two feet of standing water. For FT exercises, from 300 to 1000 gallons of flammable materials were placed in the pits, ignited, and extinguished with a protein-based foam, AFFF, or chlorobromomethane (CB). Carbon tetrachloride may have been used as an extinguishing agent during the early years of pit operation. Materials burned in the pit during training exercises consisted of JP-4 fuel brought in by tank truck, as well as drummed materials such as waste oils, thinners, and solvents which were not accepted by DPDO for disposal.

FIGURE 4.2

DULUTH IAP
FIRE TRAINING AREAS



SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

After completion of a fire training exercise, waste materials and residue remained in the pit. Due to the depth and volume of the pit, burn materials and extinguishing agents and residue from training exercises remained in the pit without overflowing. FT activities during this early period were conducted as frequently as once per week, although once per month was more typical.

The pits at FT-1 were abandoned after construction of FT-2 north of the access road in the early 1960's. The area around FT-1 was levelled and the pits filled in at this time.

From the early 1960's to the present, FT activities have been conducted in the area designated as FT-2 on Figure 4.2. Training exercises were originally conducted in an excavated area of the site; however, a perimeter berm was removed and the area graded in the early 1970's. The present burn area is circular, approximately 100 feet in diameter. Runoff from the site is uncontained and drains into a swampy area north of the site and eventually north to Rice Lake.

Typically, two training exercises are conducted each month. Prior to a training exercise, the ground is saturated with water to minimize infiltration. Up to 500 gallons of JP-4 fuel are presently burned during a typical training exercise. In the past, contaminated fuels and drummed waste materials such as oils, paint thinners, and solvents were also burned in the pit. After ignition of the training fire, the burn is extinguished with approximately 30 gallons of AFFF. A protein-based foam and chlorobromomethane were used in the past. Residual materials from the training exercises remain in the burn area, infiltrate into the ground, or contribute to surface runoff.

WASTE STORAGE AND DISPOSAL OPERATIONS

The on-site facilities which have been used for management of solid and liquid wastes at Duluth AFB can be categorized as follows:

- DPDO storage
- Hazardous waste storage
- Disposal and dump sites
- Radioactive waste disposal sites
- Wastewater treatment system
- Storm Sewers

- Sanitary Sewers
- Oil/water Separators
- Septic Tanks and Seepage Fields

The types of waste management facilities are discussed individually herein.

Defense Property and Disposal Office (DPDO)

Waste POL, JP-4, hydraulic fluids, transformers and hazardous materials in addition to tires, appliances and spare parts are typical of the types of material handled through DPDO. Materials of concern at DPDO from a handling, storage and ultimate disposal standpoint include the following:

- DDT drums
- Waste fuel oil/solvents
- PCB transformers

Prior to 1965 the DPDO operation was located near Building 147 (Site S-1). Since 1965 the DPDO operation has been located at Building 125 (Site S-2). In addition, waste fuels have been stored for the past year across the road from Building 125 at a base supply drummed oil storage area (Site S-3). Each DPDO storage area is illustrated in Figure 4.3.

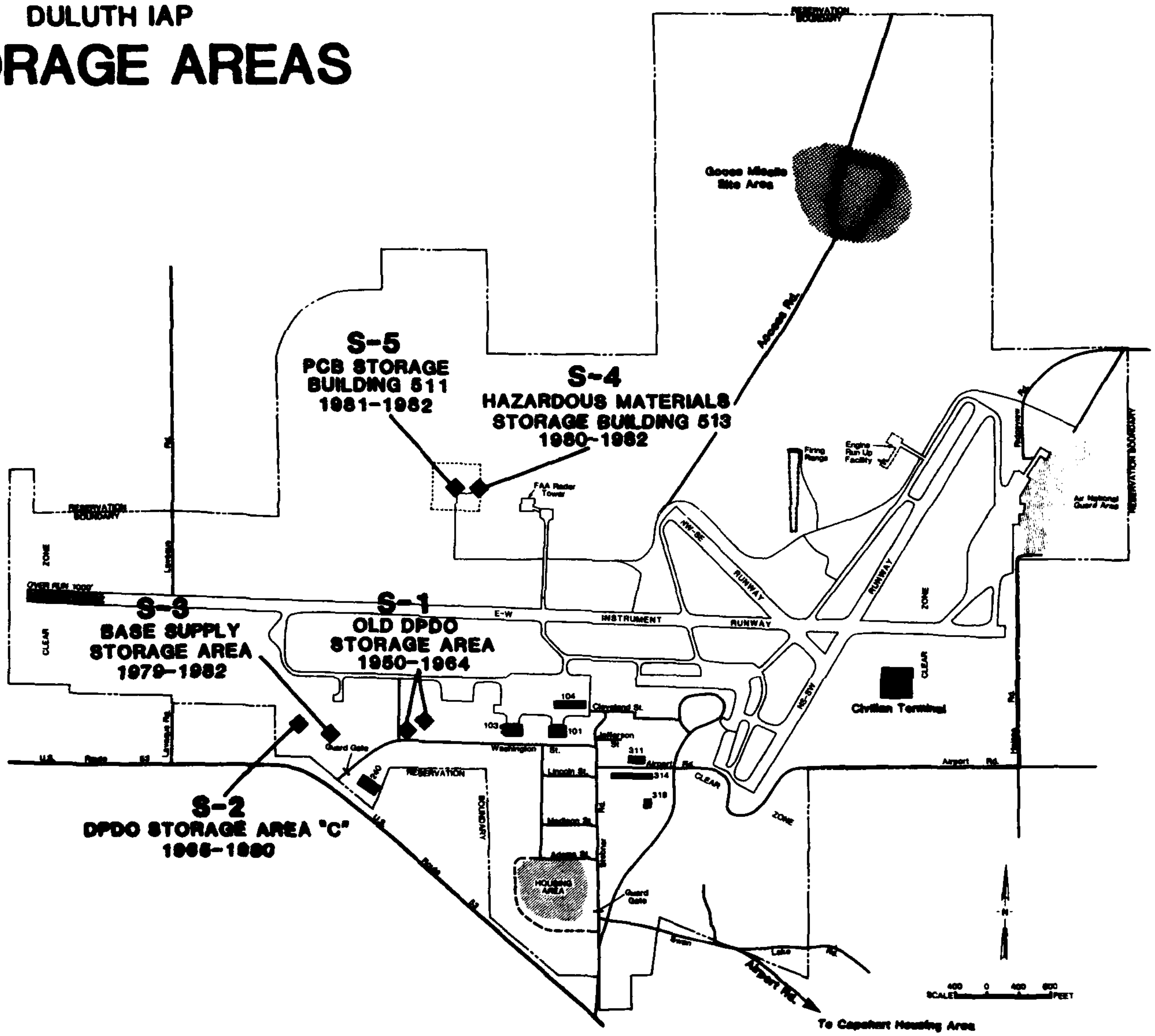
Site S-2 DPDO Storage Area

From 1965 to 1980 waste POL, waste solvents and chemicals were stored in Area "C" of the DPDO storage Site S-2 as illustrated in Figure Nos. 4.3 and 4.4. The site is approximately 90 feet long and 75 feet wide. This site is unfenced, unlined and borders a drainage ditch which eventually drains to Rice Lake. The maximum number of drums stored at any time at this site was 80 to 100 55-gallon drums based on personnel interviews. No major spills in this area have been recorded, however, minor drum leaks occurred in the past. Several drums of waste oil contaminated soil were removed from this site in 1980. This material was spread within the current fire training area (Site FT-2). This site is no longer used for storage.

Due to the proximity of Area "C" to the drainage ditch the potential for contaminant migration exists. No other areas within the

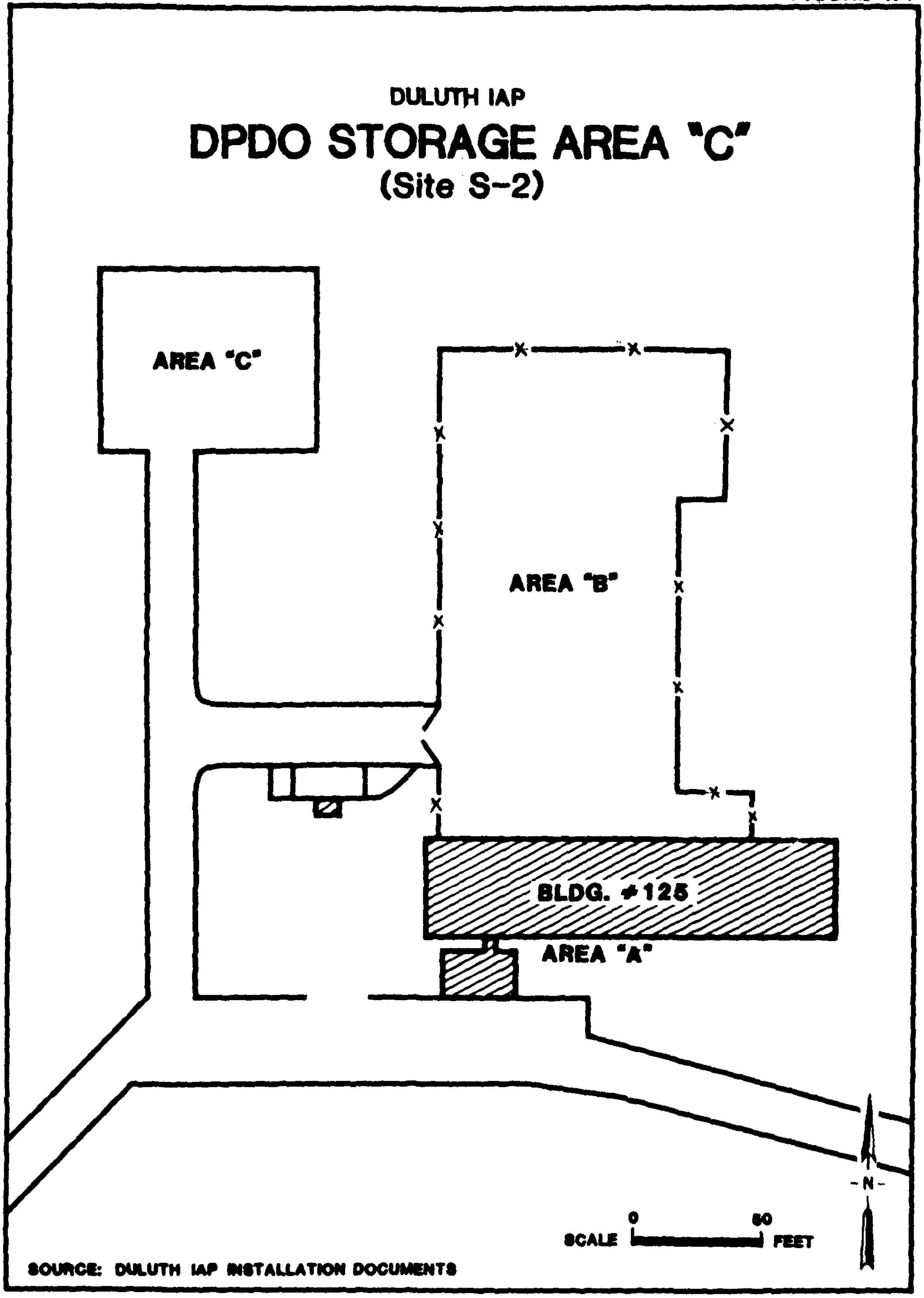
FIGURE 4.3

DULUTH IAP
STORAGE AREAS



SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

FIGURE 4.4


DULUTH IAP
DPDO STORAGE AREA "C"
(Site S-2)
AREA "C"
AREA "B"
BLDG. #125
AREA "A"
N
0
50
SCALE
FEET
SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

present DPDO storage area were used for liquid storage. Hence, no potential for migration of contaminants exist at other areas.

Site S-1 Old DPDO Storage

From 1950-1964 the base salvage yard area and DPDO storage area was located north of Washington Street near Building 147 as illustrated in Figure 4.3. Minor leakage of drums of waste materials likely occurred at this site. A potential for contamination exists at this site.

Site S-3 Base Supply Storage Area

As depicted in Figure 4.3 an open drum storage area (Site S-3) which is a 120 feet by 80 feet diked and paved area is used to contain 55 gallon drums of new and waste POL. The area is contained and no evidence of past contamination at the site exists.

Hazardous Waste Storage

Several other hazardous material and waste storage sites are located on Duluth AFB. These sites are areas of concern and were reviewed during the on-site survey. These sites are also illustrated in Figure 4.3.

Site S-4 Hazardous Material Storage Building 513

Since October, 1981 all hazardous waste materials at Duluth AFB have been stored at Building 513. This totally enclosed building with eight bay areas is used as a storage area for the types of hazardous materials illustrated in Table 4.3. No record of spills exists at this site. Prior to October, 1981 many of these materials were stored in building 147 (Site S-1).

Site S-5 PCB Storage Facility

All used PCB transformers are stored at the PCB Storage Facility (Site S-5) in Building 511. The storage area is located on a concrete slab and is totally enclosed with a 6-inch containment dike. PCB items stored at this facility include:

- 26 capacitors of various sizes (45-80 ppm PCB)
- 24 transformers of various sizes (18-140 ppm PCB)
- 15 55-gallon drums of PCB and mineral oil mixtures.

No evidence or records of spillage exists.

Disposal and Dump Sites

The majority of general refuse and waste materials generated at Duluth AFB in the past has been disposed off base in the Duluth

TABLE 4.3

HAZARDOUS WASTE STORAGE FACILITY INVENTORY

Bay Area	Material	Quantity
1	DDT (75% powder)	7-50 lb cans, 2-20 lb cans
	DDT (10%)	4-5 lb cans
	DDT (unknown %)	± 25 gals
2	Sodium Hexametaphosphate	1-100 lb can
	Unknown liquid	1-5 gal can
	Unknown powder	300 lbs
3	Malathion (57%-95%)	3-55 gal drums, 21-5 gal cans
4	Cyclohexlamine	55 gal drum
	Methyl Ethyl Ketone	5 gal can
5	Sodium Arsenite	3-30 gal drums
6	Dieldrin (18.6%)	11-5 gal cans
	Diazinon (2% dust)	1-50 lb can, 1-25 lb can
	Aircraft Paint stripping residue	± 25 gals
	Lindane (12.2%)	4-25 gal cans
	ABATE granules	6-25 lb bags
	Hydraulic fluid	± 25 gals
7	Monuron (80%)	2-50 lb cans
	Calcium Hypochloride	± 75 lbs
	Tanex	110 lbs
8	Chlordane (72%)	15-5 gal cans
	Chlordane (5% dust)	25 lb can

Note: DDT removed by DPDO in November, 981.

Municipal Landfill located near the National Guard Area. However, several disposal sites for construction rubble and hardfill materials existed on the base in the past. In addition, empty drums have been found in several areas. No records exist regarding these disposal and dump sites. A majority of the information concerning these sites was collected through personnel interviews with current and retired employees and a review of aerial photography. A description and evaluation of each site is presented herein. Table 4.4 summarizes pertinent information for each of the disposal sites illustrated in Figure 4.5.

Site D-1 Dump

Site D-1 is located in a pocket swamp area north of the abandoned Goose Missile Site bunkers and to the east of the access road. Approximately fifteen empty and rusty 20% DDT drums were observed scattered throughout an approximate 100 feet by 75 feet area (See Appendix F - Figure F.2). None of the barrels contained any original contents nor were they recently discarded. A sample of the swamp water was collected by the Base Bioenvironmental Engineering Section and analyzed by OEHL for DDT isomers. Trace quantities (<0.02 μg/l) of DDT, DDD, and DDE were detected. A potential for migration of pollutants from this site to Rice Lake exists.

Site D-2 Dump

Site D-2 is also located north of the abandoned Goose Missile Site to the west of the access road in a wooded ravine area as illustrated in Figure 4.5. Approximately 10 empty and rusty 55 gallon drums of deicing agent were observed here in October, 1981. These drums had apparently been there a long time and were all empty. No other waste materials were observed in this area and it is unlikely that the area contains any deposited waste materials covered by fill.

Site Nos. D-3, D-4, D-5 Dumps

Site D-3 is also located north of the abandoned Goose Missile Site further west of the access road in a wooded ravine area as illustrated in Figure 4.5. Several empty, rusty barrels of petroleum products were observed here in October, 1981. No evidence of contamination or other fill materials exists. The site was probably a dump area for a few empty barrels.

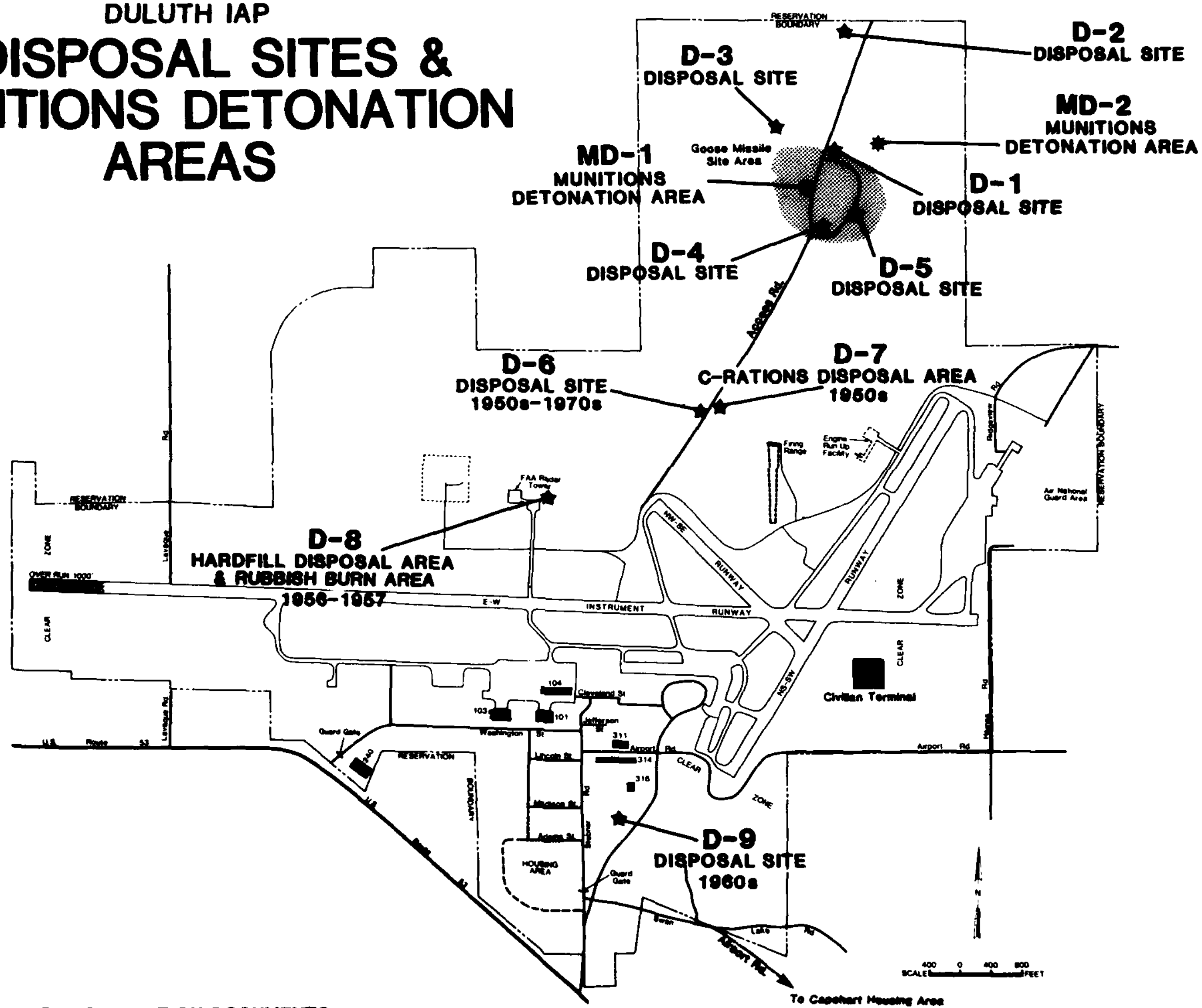
Site D-4 is located south of the abandoned Goose Missile site marker in a swampy pocket area as depicted in Figure 4.5. Two empty

TABLE 4.4
SUMMARY OF DULUTH AFB DISPOSAL SITES

Site No.	Site Name	Period of Operation	Approximate Area	Suspected Types of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage
D-1	Goose Missile Site Dump	Unknown	Approximately 100'x75'	15-20% empty DDT drums hardfill, scrap metal	Based on visual inspection the site appears to be surface dumping into the swampy area only	Unclosed open dump area	Swampy area, glacial drift	To Rice lake
D-2	Goose Missile Site Dump	Unknown	Approximately 50'x50'	10-55 gallon empty drums deicing agent	Surface dumping into a wooded ravine area	Unclosed open dump area	Swampy area, glacial drift	To Rice Lake
D-3	Goose Missile Site Dump	Unknown	Approximately 50'x50'	Empty petroleum product barrels	Surface dumping into a wooded ravine area	Unclosed open dump area	Swampy area, glacial drift	To Rice Lake
D-4	South Goose Missile Bunker Dump	Unknown	Approximately 25'x35'	Several empty drums of unknown materials	Surface dumping into a swampy pocket area	Unclosed open dump area	Swampy area, glacial drift	To Rice Lake
D-5	East Goose Missile Site Dump	Unknown	Unknown <1 acre	General rubbish, oil cans, filters from diesel engines No known drums	Surface dumping	Unclosed open dump area	Swampy area, glacial drift	To Rice Lake
D-6	Runway 13 NE Disposal Area	1950's-1970's	<1 acre	General rubbish, hardfill, aircraft parts, empty drums, drums partially containing chemicals (unconfirmed)	Area fill method waste depth & fill depth is approximately 3'-4'	Closed with local soil cover. Some scattered debris still located on surface	Glacial drift	To Rice Lake
D-7	C-ration Disposal Area	1950's	———	C-rations from WWII, hardfill	Area fill method	Closed with a foot of local soil cover	Glacial drift	To Rice Lake
D-8	Hardfill Burn Area	1956-1957	Unknown	Scrap metal, construction rubble, burnt refuse	Filled in gully with waste material and covered with local soil	Closed with local soil cover	Glacial drift	To Rice Lake
D-9	Disposal Pit	Mid-1960's	8' long by 7' deep pit	Percuric acid, acetone dumped from medics clinic - small amounts	Filled the pit and covered with local soils	Closed with local soil cover	Glacial drift	To Miller's Creek

DULUTH IAP

DISPOSAL SITES & MUNITIONS DETONATION AREAS



SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

rusty drums of unknown origin were deposited here (See Appendix F - Figure F.3). Water samples were collected, at this site, and analyzed. No contamination was detected.

Site D-5, also illustrated in Figure 4.5, is a relatively small past surface dumping site. Oil cans, general rubbish, filters from diesel engines were observed at this site in October, 1981. No drums are known to exist here. The potential of contamination migration is considered minor considering the minor quantity and type of wastes disposed here.

Site D-6 Disposal Area

The D-6 disposal site, northeast of Runway 13, has been used since the 1950's for disposal of construction rubble, landfill and general rubbish. The site has been filled about 3-4 ft. above the access road level. Based on personnel interviews this site may also contain some old aircraft parts and drums. Some key personnel suggested that both empty drums and drums containing non-burnable and non-recoverable chemicals may have been disposed here from time to time. This site is one of the few areas where an area fill method was practiced on Duluth AFB. No leachate has been observed at this site. However, the potential for migration of contaminants to local swamps and eventually to Rice Lake exists.

Site D-7 Disposal Area

Site D-7, northeast of Runway 13 on the east side of the access road, was used for burial of old C-rations and hardfill materials such as fencing and construction rubble during the 1950's. No potential for contamination exists at this site due to the nature of the wastes disposed of.

Site D-8 Hardfill Burn Area

Site D-8 was used as a burial area for small quantities of scrap metal and rubbish. Some non-hazardous materials were also burned here. No potential for contamination exists at this site.

Site D-9 Disposal Pit

During the mid-1960's small amounts of percuric acid and acetone were dumped from the medics clinic into a small pit (8'x7') located at Site D-9 on Figure 4.5. The pit contained small amounts of garbage and was filled with local soil. Due to the small quantities of waste material disposed and the location of the site a minor potential for contaminant migration exists.

Site Nos. MD-1, MD-2 Munitions Disposal Sites

Also illustrated in Figure 4.5 are two munitions disposal sites used during the 1950's to 1972. Pure explosives expended by demolition averaged 2000 pounds per year, totaling approximately 25,000 items ranging from small arms ammunition to aircraft catapults. Due to the nature of the materials exploded and the location of the sites the potential for contamination migration is considered minimal.

Radioactive Waste Disposal Site (RD-1)

In the 1950's, low level radioactive materials such as cathode ray tubes, scopes and watch dials were disposed in a 15 feet deep trench approximately forty feet long at Site RD-1, illustrated in Figure 4.6. These waste materials were covered with garbage and general refuse followed by local soil material. Due to the nature of these low level radioactive materials, the length of time since disposal and the location of the site, no potential for contamination migraton exists.

Waste Treatment System

An Imhoff tank treatment system was used for treatment of sanitary wastes prior to 1969 at which time the waste treatment plant was demolished and sanitary wastes were then diverted to the Duluth Municipal system.

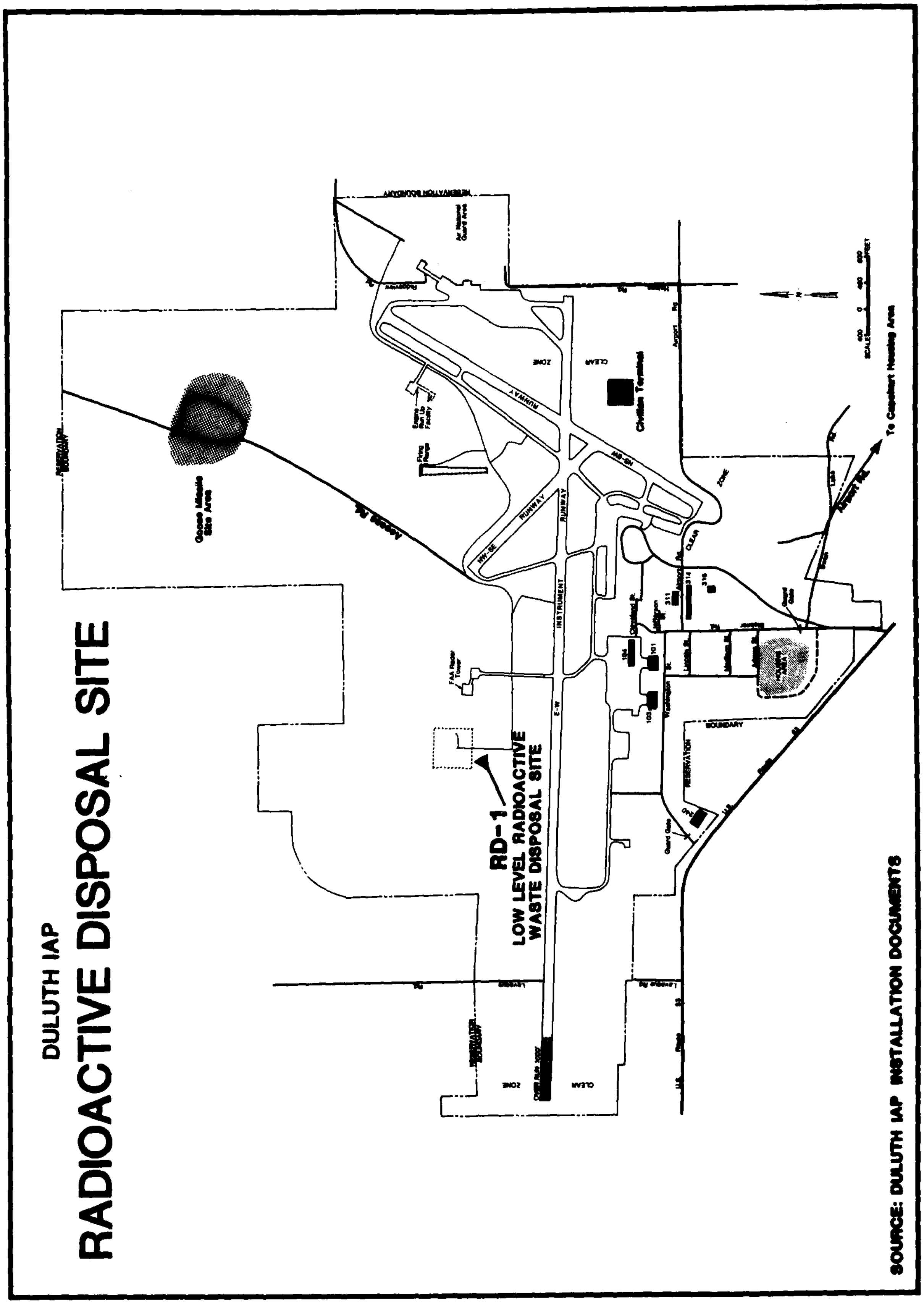
Sanitary Sewer System

The base sanitary sewage lift station was sampled quarterly for pesticides during the spring of 1980 through 1981. DDT, Dieldrin, Endrin, DDD, DDE and Heptachlorepoxide were detected at less than 1 μg/l during only one sample period (June 3, 1981). During subsequent sampling periods pesticides were not detected. The source of these residual pesticide concentrations is presently unknown, but is not a result of past disposal site contaminant migration.

Septic Tanks

There are three septic tanks on Duluth IAP which were previously used by the base. These septic tanks are located at Building 125, the ADC Ammo Storage Area and the Radar Approach Control area. Based on the on-site survey, these units have been used primarily for disposal of sanitary sewage and should not pose a hazard from the standpoint of possible ground water contamination.

FIGURE 4.6


DULUTH IAP
RADIOACTIVE DISPOSAL SITE
RD-1
LOW LEVEL RADIOACTIVE
WASTE DISPOSAL SITE
Civilian Terminal
RUNWAY
INSTRUMENT
CLEAR
ZONE
RESERVATION BOUNDARY
SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

Oil/Water Separators

There are two oil/water separators located on Duluth IAP. The recovered oil is sold to an off-site contractor and the wastewaters enter the sanitary sewer. Based on the on-site survey those units should not pose a ground-water contamination hazard.

EVALUATION OF PAST DISPOSAL FACILITIES

Eleven sites associated with Duluth IAP were identified as having potential for contamination or contaminant migration. These sites have been assessed using a rating system which takes into account factors such as site characteristics, waste characteristics, potential for contamination and waste management practices. The details of the rating procedure are presented in Appexdix G and the results of the assessment are summarized in Table 4.5. Rating scores were developed for the individual sites and the sites are listed in order of ranking. The rating system is designed to indicate the relative need for more detailed investigation. The information presented in Table 4.5 should be used as a guide for assigning priorities for investigating Duluth IAP disposal sites. The ratings for the individual disposal sites are presented in Appendix H for review.

In addition to the rating information in Table 4.5, the period of operation is also presented. The system does not take into consideration a "time factor". This is especially pertinent when considering spills and the fire training areas.

The Site D-1 Disposal Site received the highest score of 64. Scores greater than 53 were also given to the FT-2 (1960-1980) and Site FT-1 (1950-1960) fire training areas. The fire training areas received higher scores due to the nature of wastes burnt at the site, and potential for waste infiltration and migration off site. Site SP-1, Tank Farm Area, and Site S-2, DPDO Storage Area "C", also received scores greater than 53. Site SP-1 contains a suspected leak of Diesel Fuel Oil No. 2.

TABLE 4.5
PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES
DULUTH IAP

SITE NUMBER	SITE NAME	PERIOD OF OPERATION	RECEPTOR SUBSCORE	PATHWAYS SUBSCORE	WASTE CHACTERISTICS SUBSCORE	OVERALL SCORE	REFER TO APPENDIX H PAGE NO.
D-1	GOOSE MISSILE SITE DUMP	UNKNOWN	38	95	60	64	H-2
FT-2	FIRE TRAINING AREA	EARLY 1960'S - 1982	48	80	60	63	H-4
FT-1	FIRE TRAINING AREA	1951 - EARLY 1960'S	37	80	60	56	H-6
S-2	DPDO STORAGE AREA "C"	1965 - 1980	54	81	30	55	H-8
SP-1	TANK FARM AREA	1980'S	39	81	48	53	H-10
D-4	SOUTH GOOSE MISSILE BUNKER DUMP	UNKNOWN	38	95	16	50	H-12
D-2	GOOSE MISSILE SITE DUMP	UNKNOWN	42	80	24	49	H-14
D-6	RUNWAY 13 NE DISPOSAL AREA	1950 - 1970'S	42	81	27	48	H-16
S-1	OLD DPDO STORAGE AREA	1950 - 1964	46	74	24	48	H-18
D-9	DISPOSAL PIT	MID - 1960'S	46	80	12	44	H-20
RD-1	LOW LEVEL RADIOACTIVE WASTE DISPOSAL	1950'S	47	81	12	44	H-22

SECTION 5

CONCLUSIONS

SECTION 5

CONCLUSIONS

The goal of Phase I of the IRP is to identify the potential for environmental contamination from past waste disposal practices at Duluth IAP and to assess the probability *of contaminant* migration. Based on the results of the project team's field inspection, review of records and files, and interviews with base personnel, past employees and state and local government employees, the conclusions given below have been developed. The conclusions are listed by category for the sites identified on Duluth IAP. Table 5.1 contains the priority ranking of potential contamination sources at Duluth IAP.

1) <u>Disposal and Dump Sites</u>

   a. Disposal site D-1, the Goose Missile Site Dump, which contains approximately 15 empty DDT drums has a moderate potential for migration of contaminants. Analysis of surface water within the swampy area around the dump site has indicated the presence of trace levels of DDT isomers. The site received an overall score of 64.

   b. Disposal sites D-4, D-2, D-6, and D-9 have a low potential for migration of contaminants due to the types and estimated quantities of wastes disposed at these locations. These sites received scores of 50, 49, 48, and 44 respectively.

2) <u>Fire Training Areas</u>

   a. Fire Training area FT-2 has a moderate potential for migration of contaminants. Training exercises at FT-2 which have been conducted since 1960 have utilized waste oils, solvents, thinners and JP-4. This pit is unlined. Runoff from the site drains into a swampy area north of the fire training area and eventually north to Rice Lake. Fire training area FT-2 was given an overall score of 63.

TABLE 5.1

PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site Name	Score
1	D-1 Goose Missile Site Dump	64
2	FT-2 Fire Training Area	63
3	FT-1 Fire Training Area	56
4	S-2 DPDO Storage Area "C"	55
5	SP-1 Tank Farm Area	53
6	D-4 South Goose Missile Site Dump	50
7	D-2 Goose Missile Site Dump	49
8	D-6 Runway 13 NE Disposal	48
9	S-1 Old DPDO Storage Area	48
10	D-9 Disposal Pit	44
11	RD-1 Low-level Radioactive Waste Disposal	44

Note: This ranking was performed according to the Hazardous Evaluation Methodology described in Appendix G. Individual site rating forms are in Appendix H.

b. Fire Training area FT-1 contained two pits used for training activities prior to 1960. The pits never overflowed and residual waste materials most likely seeped into the ground. This area is believed to pose a lower potential for migration of contaminants than FT-2 since the site has been closed with local soils. FT-1 was given an overall score of 56.

3) Spill Areas

A suspected Diesel Fuel Oil No. 2 leak has occurred near the Tank Farm area (Site Sp-1). This site received a score of 53.

4) Hazardous Waste Storage Areas

a. The DPDO Storage Area "C" (Site S-2) which served as a storage site for waste materials in 55 gallon drums has a moderate potential for contaminant migration due to the minor amount of spillage which occurred. This site received a score of 55.

b. The old DPDO storage area (Site S-1) which also served as a storage site for waste materials has a low potential for contaminant migration due to the minimal storage which occurred and the location of the site. This site received a score of 48.

5) Radioactive Disposal Site

The radioactive disposal site RD-1 has a low potential for migration of contaminants. The disposal site is small and contains low-level radioactive waste materials. The site received a score of 44.

SECTION 6

RECOMMENDATIONS

SECTION 6

RECOMMENDATIONS

In order to aid in the comparison of the 12 sites on Duluth IAP with those sites identified in the IRP at other Air Force Bases, a priority rating scale was developed. The sites at Duluth IAP with overall scores greater than 53 are of primary concern, based on their potential for waste migration. Further investigation is recommended. Sites of secondary concern are those with scores from 0 to 52 and further investigations for these sites is not recommended unless data collected from other locations indicate a potential problem could exist at one of these sites.

The following recommendations are made to further assess the potential for contaminant migration from waste disposal areas at Duluth IAP. The recommended monitoring program for Phase II is summarized in Table 6.1.

1) The Goose Missile Site Dump (Site D-1) is considered to have a moderate potential for migration of contaminants and monitoring of this site is recommended. Since the suspected sources of contamination (15-55 gallon drums) are situated in a swamp depression area (discharge area) monitoring wells are not required. It is recommended that approximately ten surface water and sediment samples be collected at various equidistant locations throughout the dump site. These samples should be analyzed for the parameters in List B of Table 6.2 to determine the extent of contamination.
2) Fire Training Site FT-2 is considered to have a moderate potential for migration of contaminants and monitoring of the site is recommended. A monitoring system consisting of one upgradient well and three downgradient wells should be installed. At this time, it is believed that wells comprising such a system will have a total depth on the order of 20 feet. At a minimum the parameters in List A of Table 6.2 should be monitored.

TABLE 6.1

RECOMMENDED MONITORING PROGRAM FOR PHASE II - DULUTH IAP

Site	Rating Score	Recommended Monitoring	Comments
Goose Missile Dump Site D-1	64	Collect approximately ten surface water and sediment samples at equidistant locations throughout the dump site and analyze for the parameters in List B of Table 6.2.	
Fire Training Site FT-2	63	Install monitoring well system consisting of 1 upgradient well and 3 downgradient wells to an approximate 20 feet depth. Analyze samples for parameters in List A of Table 6.2.	
Fire Training Site FT-1	56	Collect three soil core boring samples of approximate 10 feet depth around the FT-1 site. Analyze these samples for the parameters in List A of Table 6.2.	If the core boring soil samples indicate contamination, a more extensive monitoring program will be required.
DPDO Storage Area "C" Site S-2	55	Collect four soil core borings samples of approximate 10 feet depth around the DPDO storage area "C" Site. Analyze these for the parameters in List A of Table 6.2.	Same as comment above.
Tank Farm Area Site SP-1	53	Install monitoring well system consisting of 1 upgradient well and 3 downgradient wells to an approximate 20 feet depth. Analyze samples for parameters in List A of Table 6.2.	

TABLE 6.2

LIST OF RECOMMENDED ANALYTICAL PARAMETERS

LIST A

Total Organic Carbon

pH

Total Organic Halogen

Oil and Grease

LIST B

DDT

DDD

DDE

Total Organic Carbon

pH

Total Organic Halogen

3) Fire Training Site FT-1 also has a moderate potential for contaminant migration although the age of the site and the fact that it is located in a wet area lessens the probability of existing contamination. However, three core boring locations are recommended around the perimeter of the site at approximately 10 foot depths. The soil samples should be analyzed for the parameters in List A of Table 6.2 to determine the presence of any suspected contaminants. If contamination is detected a more extensive monitoring system would have to be considered.

4) Tank Farm Area (Site Sp-1) has a moderate potential for contaminant migration and monitoring of the site is recommended as illustrated in Table 6.1.

5) DPDO Storage Area "C" (Site S-2) has a moderate potential for contaminant migration and soil monitoring of the site is recommended as illustrated in Table 6.1.

APPENDICES

APPENDIX A

PROJECT TEAM QUALIFICATIONS

J. R. Absalon, C.P.G.

W. G. Christopher, P.E.

D. Johnson

Biographical Data

JOHN R. ABSALON
Hydrogeologist

PII Redacted

[redacted]

Education

B.S. in Geology, 1973, Upsala College, East Orange, New Jersey

Professional Affiliations

Certified Professional Geologist (Indiana No. 46)
Association of Engineering Geologists
Geological Society of America
National Water Well Association

Experience Record

1973-1974 Soil Testing Incorporated-Drilling Contractors, Seymour, Connecticut. Geologist. Responsible for the planning and supervision of subsurface investigations supporting geotechnical, ground-water contamination, and mineral exploitation studies in the New England area. Also managed the office staff, drillers, and the maintenance shop.

1974-1975 William F. Loftus and Associates, Englewood Cliffs, New Jersey. Engineering Geologist. Responsible for planning and management of geotechnical investigations in the northeastern U.S. and Illinois. Other duties included formal report preparation.

1975-1978 U.S. Army Environmental Hygiene Agency, Fort McPherson, Georgia. Geologist. Responsible for performance of solid waste disposal facility siting studies, non-complying waste disposal site assessments, and ground-water monitoring programs at military installations in the southeastern U.S., Texas, and Oklahoma. Also responsible for operation and management of the soil mechanics laboratory.

1978-1980 Law Engineering Testing Company, Atlanta, Georgia. Engineering Geologist/Hydrogeologist. Responsible for the project supervision of waste management, water quality assessment, geotechnical, and hydrogeologic studies at commercial, industrial, and government

John R. Absalon (Continued)

facilities. General experience included planning and management of several ground-water monitoring programs, development of remedial action programs, and formulation of waste disposal facility liner system design recommendations. Performed detailed ground-water quality investigations at Robins Air Force Base in Georgia, a paper mill in southwestern Georgia, and industrial facilities in Tennessee.

1980-Date Engineering-Science. Hydrogeologist. Responsible for supervising efforts in waste management, solid waste disposal, ground-water contamination assessment, leachate generation, and geotechnical and hydrogeologic investigations for clients in the industrial and governmental sectors. Performed geologic investigations at eight Air Force bases and other industrial sites to evaluate the potential for migration of hazardous materials from past waste disposal practices. Conducted RCRA ground-water monitoring studies for industrial clients and evaluated remedial action alternatives for a county landfill in Florida.

Publications

"An Investigation of the Brunswick Formation at Roseland, NJ," 1973, with others, The Bulletin, Vol 18, No. 1, NJ Academy of Science, Trenton, NJ.

"Engineering Geology of Fort Bliss, Texas," 1978, with R. Barksdale, in Terrain Analysis of Fort Bliss, Texas, US Army Topographic Laboratory, Fort Belvoir, VA.

"Geologic Aspects of Waste Disposal Site Evaluations," 1980, with others, Program and Abstracts AEG-ASCE Symposium on Hazardous Waste Disposal, April 26, Raleigh, NC.

"Practical Aspects of Ground-Water Monitoring at Existing Disposal Sites," 1980, with R.C. Starr, Proceedings of the EPA National Conference on Management of Uncontrolled Hazardous Sites, HMCRI, Silver Spring, MD.

"Improving the Reliability of Ground-Water Monitoring Systems," 1981, Proceedings of the Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, University of Wisconsin-Extension, Madison, WI.

Biographical Data

WILLIAM GARY CHRISTOPHER

Environmental Engineer

[redacted]

Education

B.S.C.E. in Civil Engineering, (Magna Cum Laude), 1974
West Virginia University, Morgantown, W.Va.
M.E. in Environmental Engineering, 1975, University of Florida, Gainesville, Florida

Professional Affiliations

Registered Professional Engineer (Georgia No. 11886)
American Society of Civil Engineers (Associate Member)
West Virginia Water Pollution Control Federation

Honorary Affilitations

Chi Epsilon
Tau Beta Pi
EPA Traineeship for Master's Degree

Experience Record

1972-1974 West Virginia Department of Highways. Morgantown, West Virginia. Highway Co-op Technician. Handled inspection of drainage, concrete structures, earthwork and compaction testing for interstate highway construction within Monongalia County and Preston County. Performed field office assignments to finalize estimates and quantities for a completed section of highway construction.

1975-1977 Union Carbide Corporation, Chemicals and Plastics Division, Environcmental Engineering Department. As a process/project engineer performed environmental protection engineering for Union Carbide's Taft and Texas City Plants. Projects included process design of a rapid mix-flocculation basin for the Gulf Coast Waste

2/82

William Gary Christopher (Continued)

Disposal Authority (GCWDA) 40-Acre Facility Treatment Plant. Performed bench-scale studies of coagulant use to improve settling of aeration basin effluent biosolids at the 40-acre facility. Predicted 40-acre facility effluent BOD and effluent TSS quality following operation changes to the existing facility including addition of a limited aeration basin to the front end of the treatment plant. Performed process feasibility and conceptual design of an aeration treatment facility for Union Carbide's Texas City plant concentrated waste stream. Performed preliminary process scope and cost appraisals for sludge disposal alternatives at Texas City including: landfarming, pressure filtration-landfill and pressure filtration-incineration. Performed settling column studies for solvent vinyl resin and suspension vinyl resin waste streams and sized settling basins from the studies. Proposed bench-scale study of the effect of ethyleneamines waste stream on anaerobic treatment of Texas City concentrated wastes. Provided review assistance for a 200-acre regional industrial landfill, in-place stabilization processes for 18-acre lagoons of primary sludge and pyrolysis fuel oil mixtures at Texas City, and source reduction projects. Evaluated at UNOX compressor piping modification for the Taft Plant to reduce power consumption by 50%. Wrote preliminary operational considerations for a proposed GCWDA regional landfarm.

1977-Date Engineering-Science, Inc. Project Engineer on study for the American Textile Manufacturers Institute and EPA. Responsible for field pilot plant study and evaluation of coagulation/clarification/multi-media filtration, carbon adsorption, ozonation, coagulation/multi-media filtration and dissolved air flotation technologies for treatment of textile industry "BPT" effluents to meet future BATEA guidelines. An ancillary portion of this project included review of existing activated sludge facilities and operational practices to meet current "BPT" limits at 5 textile mill sites.

Project engineer on study for Lederle Laboratories, Pearl River, New York plant. Responsible for wastewater treatment plant evaluation and optimization study with particular emphasis on operational changes to improve performance. Treatment processes included coagulation, flocculation, primary sedimentation, oxygen activiated sludge and final sedimentation.

William Gary Christopher (Continued)

Project manager of waste treatment operations evaluation at a pharmaceutical plant. Responsibilities included operational optimization of the full-scale activated sludge process with full-scale coagulation testing, bench-scale bioreactor studies and equalization mixing and capacity studies.

Project engineer on study to determine the impact of RCRA regulations on the coal-fired utility industry. Assisted in development of design criteria and cost methodology and estimates to compare the cost impact of RCRA 3004 and 4004 regulations on fly ash, bottom ash and FGD sludge disposal on a regional and nationwide basis.

Project Manager for review of a Permit Application and design for a proposed Hazardous Waste Disposal Facility in North Carolina.

Project Manager for preparation of a "white paper" for the Department of Energy to assess major impacts of proposed RCRA 3001, 3004 and 3006 regulations on industrial coal use for power generation.

Project Manager on study to determine biotreatability of new process wastes for a pharmaceutical chemical plant and to evaluate and define options for liquid waste incineration.

Project Manager on odor control study of process wastes for a major organic chemicals company. Responsible for laboratory bench-scale and field pilot plant study involving evaluation of liquid waste, air and steam stripping, chemical oxidation, ozonation, and activated carbon adsorption. Design criteria for a biological treatment system for the odor pretreatment effluent was also developed from bench-scale bioreactor studies.

Project Manager on a study to provide a preliminary evaluation of advanced waste treatment technologies required for upgrading an existing activated sludge facility treating organic chemical and pharmaceutical wastes with high COD and nitrogenous concentrations.

Project Manager on a biological treatability study to provide expanded waste treatment facilities for a major organic chemicals firm. Responsibilities included laboratory bench-scale and pilot scale treatability and sludge handling studies involving waste characterization, activated sludge treatability, aerobic digestion, gravity thickening, dissolved air flotation, belt filter press sludge dewatering, plate and frame pressure

William Gary Christopher (Continued)

filter, vacuum filter (rotary precoat), and centrifugation for nine different raw waste streams.

Project Manager for a project involving process selection and preliminary engineering design for a pulp and paper mill waste treatment facility.

Project Manager on Solid and Hazardous Waste study for a diverse chemicals and plastics production facility. Responsibilities included RCRA Interim Status Compliance, RCRA Manifest Implementation and plant training, RCRA Notification and Permit Part A applications. Detailed Solid Waste inventories by production unit and classification of wastes according to RCRA were developed. Segregation of wastes, recycle/recovery and ultimate disposal options including incineration and secure landfills were evaluated for the short-term. Long-term evaluations will be considered in Phase II of the Study.

Project Manager on Solid and Hazardous Waste study for a diverse organic chemicals manufacturing facility. Long-term alternatives for storage, handling, treatment and disposal of a variety of types of hazardous wastes were evaluated based on technical performance and economic comparisons. Alternatives evaluated included solid and liquid incineration, landfill, landfarm, solidification/fixation, and physical volume reduction (shredding,compaction). Developed a detailed Spill Control and Best Management Practices Manual.

Project Manager for a waste treatment plant capacity evaluation for a silicon wafer manufacturing facility. Bench-scale and pilot scale coagulation and settling column studies were performed in addition to field scale oxygen transfer tests to predict maximum design organic and hydraulic loadings for an existing activated sludge waste treatment facility.

Other recent projects include development of the work plan and experimental program for an American Cyanamid Company organic chemical plant primary treatment study, development of design specifications for a pharmaceutical production facility waste treatment plant and mixed liquor coagulation operations assistance for a plastics production waste treatment facility.

Technical Publications

"Magnesium Recovery from a Neutral Sulfite Semi-chemical Pulp and Paper Mill Sludge," Master of Engineering Research Project, University of Florida, Gainesville, Florida 1975.

William Gary Christopher

"Siting Considerations for Hazardous Waste Disposal Facilities," presented at the Georgia Environmental Health Association Conference, Jekyll Island, Georgia, July, 1981. (Co-author T.N. Sargent)

W. G. Christopher, "Hazardous Waste Management," Seminar presented to Capitol Associated Industries, Inc., Raleigh, North Carolina, August 21, 1981

W. G. Christopher, "A Solid and Hazardous Waste Management Program for Industrial Facilities," Industrial Wastes Magazine (publication pending), 1981.

Biographical Data

DAVID G. JOHNSON

Environmental Engineer

[redacted]

PII Redacted

Education

B.S. in Civil Engineering with Highest Honors, University of Texas, Austin, Texas, 1977

M.S. in Engineering (Environmental Health), University of Texas, Austin, Texas, 1979

Professional Affiliations

Water Pollution Control Federation

Honorary Affiliations

Tau Beta Pi
Chi Epsilon
Phi Kappa Phi
Phi Eta Sigma

Experience Record

1976-77	University of Texas, Austin, Texas, Dept. of Civil Engineering - Research Assistant II. Performed data reduction and analysis and application of computer models to predict dynamic wheel loadings on pavements and bridges.
1977-78	University of Texas, Austin, Texas, Dept. of Engineering (Environmental Health) - Research Assistant II. Performed literature review and analysis of data pertaining to the sources and influx of nitrogen species into confined aquifers, and the fate of ammonia used for in-situ uranium solution mining.
1978-80	Espey, Huston & Associates, Inc. - Staff Engineer I. Preparation of Federal Flood Insurance Studies for thirteen coastal communities and four counties in Texas. Responsible for the data collection, hydrologic and hydraulic analyses and report writing, as well as coordination of staff engineers and technicians involved in the project. Extensive use was made of the computer program HEC-2. Represented the company at numerous community coordination meetings. Prepared outfall drainage studies for the communities of Refugio and Missouri City, Texas, outlining existing drainage problems and making recommendations to relieve them. Designed major drainage ditch improvements for a drainage system in Houston, Texas.

David G. Johnson (Continued)

1980-Present Engineering-Science, Inc. Project Engineer on 201 Step 1 studies for the communities of Edinburg and Sugar Land, Texas. Activities included preparation of an Environmental Information Document for Edinburg and Facility Plan for Sugar Land.

Project Engineer for Phase 1 Installation Restoration Program projects for the Department of Defense. Evaluated radioactive and hazardous materials handling and waste disposal activities at several Air Force bases to identify practices potentially resulting in groundwater contamination and contaminant migration beyond property boundaries. Past disposal sites were ranked to establish a priority basis for futher investigations.

Project Engineer involved with the preparation of an EIS for a new central Florida phosphate mine. Project activities included an analysis of radionuclide redistribution as a result of mining and an evaluation of potential radiological impacts.

Project Manager on an evaluation of fly ash disposal alternatives for a large power plant. Objectives of the project included assessment of collection, transportation, and disposal methods, as well as the potential for fly ash reuse.

Project Engineer in charge of coordinating bench-scale biological treatability studies on a coal gasification wastewater project. Systems using various amounts of powdered activated carbon were evaluated. Adsorption isotherms and temperature-rate dependency tests were also performed.

Project Engineer in charge of the preparation of conceptual wastewater treatment system design for a major oil refinery expansion. Activities included estimation of waste loads, and evaluation and conceptual design of collection and treatment facilities. Project Manager in charge of discharge permit preparation and application.

Project Engineer involved with the development of a wastewater management program for a major chemical company. Treatment technologies evaluated included granular carbon adsorption, powdered activated carbon adsorption in an activated sludge system, incineration, solvent extraction, steam stripping, chemical treatment, deep-well injection, and wet air oxidation.

Project Engineer in charge of coordination of bench-scale testing for a secondary oil removal and slop oil handling system for an organic chemical plant wastewater. Dissolved air flotation tests were run to

David G. Johnson (Continued)

identify optimum operating procedures. Batch slop oil screening tests were performed to identify effective oil/solid/water emulsion-breaking agents.

Publications

Brasewell, J., M. Breland, M. Chang, D. Hill, D. Johnson, R. Schechter, L. Turk, and M. Humenick. 1978. "Literature Review and Preliminary Analysis of Inorganic Ammonia Pertinent to South Texas In-Situ Leaching." Cehter for Research in Water Resources Report No. CRWR-155, EHE 78-01.

Garwacka, K., D. Johnson, M. Walsh, M. Breland, R. Schechter, and M. Humenick. 1979. "Investigation of the Fate of Ammonia from In-Situ Uranium Solution Mining." Technical Report EHE 79-01.

Johnson, D., and M. Humenick. 1979. "Nitrification and In-Situ Uranium Solution Mining," SPE No. 8321. Presented at the 1979 SPE Annual Technical Conference and Exhibition, Sept. 23-26, 1979 in Las Vegas, Nevada. Also presented at the Texas Section ASCE Fall 1979 meeting on October 4-6, 1979, at College Station, Texas.

Johnson, D. 1979. "Nitrification and In-Situ Uranium Solution Mining." Masters Thesis, University of Texas, Austin, Texas. August 1979.

APPENDIX B

INSTALLATION HISTORY

APPENDIX B
INSTALLATION HISTORY

INSTALLATION HISTORY

Duluth International Airport was originally known as Williamson-Johnson Airport. From 1948 to March 1, 1951, the airport was used by the 133rd Fighter Group of the Minnesota Air National Guard (ANG). On March 1, 1951, the Air Defense Command (ADC) placed ANG facilities at the airport on active status, and assigned jurisdiction to the Eastern Air Defense Force (EADF). Command jurisdiction shifted to the Central Air Defense Force (CADF) on May 20, 1951. Facilities available on base at this time included a hangar, motor service building, paint shop, crash and rescue station, heating plant, and temporary shacks next to the hangar. The facilities were used to support air defense organizations, including the 179th Fighter/Interceptor Squadron which flew F-51D and T-33 aircraft.

The period from May 1951 to November 1952 was one of heavy construction at the airport. During this time the following facilities were constructed: a ground control approach (GCA) and instrument landing system (ILS) navigation aids, a remote transmitter and receiver building, alert hangars, a base exchange, ammunition storage area, runway and taxiway extensions and improvements, a central heating plant, steam distribution system, water and sewage line, barracks, mess facility, administrative buildings, readiness building, a new crash and rescue station, an NCO open mess, and VHF radio facilities. Approximately 80 acres of ANG facilities were leased by the Air Force, and about 1,243 additional acres were used by base units.

During November and December 1952 the ANG facilities were returned to the State of Minnesota. The airport was also renamed the Duluth Municipal Airport (MAP).

Construction of base facilities continued from December 1952 to December 1953. Barracks, an administration building, and POL facilities were completed in January 1953. Other facilities completed during 1953 included VHF-DF navigational aids, airfield lighting and apron tie-down anchors, heating plant, water and electrical system extension, additional barracks, officers' open mess, warehouses, air installations building, paint and storage building, gas station, airmen's club, technical training building, flight simulator building, and VHF radio equipment in the control tower. Additional work was done on the ammunition storage area, instrument landing system, security fencing and lighting, and administration buildings.

Beginning in 1952, the base was occupied by the 515th Air Defense Group. The 515th was renamed the 343rd Fighter Group on August 18, 1955. Principal aircraft utilized during the 1953-1955 period included the T-6D, F-86D, and few F-80C aircraft.

An aircraft refueling hydrant system was placed in operation during the summer of 1954.

Construction of new facilities of Duluth MAP slowed during 1954. In this year, a motor maintenance building, base headquarters building, and guardhouse were completed. The instrument landing system was partially completed, and the Duluth VHF/DF navigational facility moved to its permanent location.

Also during 1954, two contracts between the Air Force and the City of Duluth were approved by the city council. These contracts extended the Air Force lease to 25 years, and required payment of an annual fee for snow removal, runway maintenance, and other services provided by the city.

On June 28, 1955, a jet engine field maintenance (JEFM) facility was established. Plans for on-base family housing units were also completed in 1955.

Construction began on the Semi-Automatic Ground Environment (SAGE) direction center at Duluth MAP in May 1956. The construction was completed and accepted by the Air Force on November 20, 1957. The facility was designated the Duluth Air Defense Sector. The 343rd Fighter Group was assigned to this sector, with the mission of protecting 70,000 square miles of northern skies from enemy attack, and was equipped with Convair F-102 Delta Daggers.

During 1956, construction began on a new jet engine test stand, support taxiway, and a GAR-1 missile storage building. Repairs were made to the east-west runway and rocket assembly building. Also during this year, an F-102 flight simulator was installed, a Terminal VHF Omni-Range (TVOR) homing device was constructed, and the J-35 (F-89D) jet engine field maintenance (JEFM) facility was replaced with a JEFM facility for servicing J-57 (F-102A) aircraft.

On November 30, 1957, the Duluth MAP was designated an electronics support base within the 31st Air Division. Also during 1957, construction was completed on the on-base family housing units, chapel, parachute shop, aircraft shelters, on-base water main, and refueling hardstand modifications.

Major base activity during 1958 centered around construction of a new GOOSE (SM-73) missile site and replacement of the main runway. A new computer system was installed at SAGE. During 1959 and 1960, 240 off-base family housing units were constructed, and the ammunition storage area, base theater, and ground power equipment storage building were completed.

The Duluth Air Defense Sector was declared operational on November 15, 1959 and given the responsibility of patrolling 70,000 square miles of the United States and additional Canadian territory. The 343rd Fighter Group remained part of the sector, and converted from the F-102 to the Convair F-106 Delta Dart aircraft during 1960.

The Duluth Municipal Airport (MAP) changed its name to the present Duluth International Airport (IAP) in 1963. The facility continued to be utilized by the Air Force, Air National Guard, and the City of Duluth.

Due to a reorganization of the Air Defense Command, the Duluth Air Defense Sector was redesignated the 29th Air Division on April 1, 1966. However, the air defense responsibility, capability, and mission remained unchanged.

Numerous changes in the 29th Air Division occurred during 1969 and 1970. Six radar squadrons were reassigned in September 1969: four to the 34th Air Division and two to the 28th Air Division. On November 19, 1969, the 29th Air Division became the 23rd Air Division. The 23rd Air Division gained eight radar squadrons and became part of the 23rd North

American Defense Region (NORAD) in 1970. The area of responsibility of the 23rd Air Division increased to approximately 750,000 square miles of U.S. and Canadian territory, including over 50 million people. The base mission remained the protection of this region against attack by hostile aircraft.

Although most of the major construction on base occurred prior to 1960, the period 1960-1970 saw several improvements and new construction projects. During this period automotive maintenance facilities, heated storage and administrative facilities, additional warehousing, an airmen dormitory, and religious educational facilities were constructed or improved. Additional facilities added since 1970 include a new post office, child care center, youth center, and data processing building. In addition, a warehouse was converted into a commissary, the base exchange was enlarged, and the heating plant was converted from coal to oil burning capability.

On August 18, 1970, the 343rd Fighter Group was deactivated and replaced by the 4787th Air Base Group. In April 1971, the 87th Fighter Interceptor Squadron at Duluth IAP was transferred to K. I. Sawyer AFB in Michigan to replace the 62nd Fighter Interceptor Squadron which had been deactivated. The flying mission at Duluth IAP was greatly decreased as a result of these changes. Several active Air Force T-33 aircraft remained on base until November, 1981.

Missions of tenant and other organizations on base during the last several years are briefly described in the following paragraphs. In 1980 Duluth IAP was transferred from Air Defense Command to Tactical Air Command.

23rd North American Air Defense (NORAD) Region had responsibility for the air defense of a large number of midwestern states and portions of Canada. The focal point of the Region was the SAGE building which functions as the control center for air defense resources. Radar data was processed in the SAGE building to allow controllers to detect and identify hostile aircraft and control fighter aircraft. The 23rd NORAD region provided air defense for an area of approximately 900,000 square miles in 17 northcentral states and Canada. To perform air defense activities, the NORAD Region maintained operational control over air defense equipment in both the United States and Canada, including long-range radar sites and fighter interceptor units in Minnesota, Wisconsin, and Michigan.

23rd Air Division had responsibility for equipping, administering, training, and providing air defense combat-ready forces in the 23rd NORAD Region. The 23rd Air Division also exercised command jurisdiction over assigned units, activities, installations, and attached units and supported other forces as directed.

23rd Air Defense Squadron provides operational support for the 23rd NORAD Region/Air Division. This squadron also provided administrative functions, training, and housing for personnel assigned to the SAGE system, including those assigned to the headquarters of the 23rd Air Division.

USAF Clinic equips, administers, and trains all assigned or attached personnel in order to provide medical service, emergency care and treatment for nonhospital type cases, physical examinations, inspections, and immunization for all authorized personnel. Provides other bases with medical services such as flight medicine, preventative medicine, veterinary service, and dental service as required.

148 Tactical Reconnaissance Group (TRG), Minnesota Air National Guard (ANG) has a photo reconnaissance mission under the direction of the Tactical Air Command (TAC). Prior to 1976, the unit was known as the 148th Fighter Interceptor Group, flying F-101 Voodoo aircraft as an integral part of the 23rd NORAD Regional defense system. Currently F-4 aircraft are used.

Detachment 8, 12th Weather Squadron provided all weather support to the 23 NORAD Region/23 Air Division, consisting primarily of short range forecasting in support of air defense units.

Detachment 3, 1913 Communications Group (AFCS) maintains Radar Approach Control, ground radios, navigational aids, weather equipment, and various communications equipment.

Defense Property Disposal (DPDO) responsible for the disposal of excess government equipment, including office equipment, vehicles, electronic equipment, and hazardous materials/waste.

Detachment 1, 4603, ADMET served as the manpower office for all units of the 23rd Air Division, including the programming of resources to accomodate new missions or workloads as well as activations and deactivations of units. The detachment also monitored contractural services and accomplished management engineering studies directed by ADCOM headquarters.

Detachment 1315, District 12, Office of Special Investigation investigates all major offenses and violations of the Uniform Code of Military Justice and conducts criminal, personal security, and counterintelligence investigations.

USAF Postal Courier Service provides mail support for Duluth International Airport.

District 23, Duluth Resident Agency performed defense investigation services in conjunction with the Office of Special Investigation.

APPENDIX C

ENVIRONMENTAL SETTING DATA

ENVIRONMENTAL SETTING DATA

BIOLOGICAL RESOURCES BASELINE ENVIRONMENT

The existing biotic environment for Duluth IAP is summarized based on information contained in the TAB A-1 Environmental Narrative as follows:

- The existing vegetation is dominated by poplar, aspen and paper-birch on slopes and uplands with a mixture of tag alder, black ash, black spruce, and tamarack adjacent to creek beds and in nearby broad swampy areas.
- No area of the base is used for field crops.
- There are no threatened or endangered plant species on base or in the Duluth area.
- Large animals found within the base include whitetail deer and the black bear.
- Approximately fifteen species of predatory birds (hawks and falcons) could either reside or migrate through Duluth IAP.
- The only threatened and endangered species (animals) with any significant chance of being found within the Duluth area are the timber wolf and several species of predator birds. These birds would include the golden eagle, the bald eagle and the peregrine falcon. Even though these birds are rare, high numbers may migrate through the Duluth area every fall.

MINNESOTA WATER QUALITY STANDARDS

The water quality stream standards classification for Duluth IAP streams are illustrated in Table C.1 along with the required stream standards for the various classifications.

DULUTH IAP SURFACE WATER QUALITY MONITORING

A range of analytical results for each of the nine water quality sampling stations on Duluth IAP are illustrated in Table C.2.

TABLE C.1

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

WATERS	REACH OR AREA INVOLVED OR LOCATION	CLASSIFICATION
Streams		
Manitou River	(S. 3, 10, T. 57, R. 6W; S. 6, 7, 8, 17, 20, 21, 28, 33, 34, T. 58, R. 6W; S. 1, 7, 8, 9, 11, 12, 16, 17, T. 58, R. 7W; S. 18, 19, 21, 26, 27, 28, 35, 36, 22, T. 59, R. 7W)	1B, 2A, 3B
Little Manitou River	(S. 2, T. 57, R. 6W)	1B, 2A, 3B
Little Marais Creek	(S. 5, 8, 16, 17, 21, T. 57, R. 6W)	1B, 2A, 3B
Mark Creek	(S. 1, 2, 3, 9, 10, T. 61, R. 2W)	1B, 2A, 3B
Martin Creek	(S. 2, 3, 11, T. 58, R. 6W)	1B, 2A, 3B
Mile Post 43 Creek	(S. 2, 3, 10, 11, 14, 15, T. 56, R. 8W)	1B, 2A, 3B
Millers Creek	(S. 12, 13, T. 50, R. 15W; S. 18, 19, 29, 30, 32, T. 50, R. 14W)	1B, 2A, 3B
Mississippi Creek	(S. 1, T. 61, R. 2W; S. 32, 33, 34, 35, T. 62, R. 2W)	1B, 2A, 3B
Mons Creek	(T. 62, 63, R. 3E)	1B, 2A, 3B
Moose Creek	(S. 31, 32, 33, 34, T. 59, R. 6W)	1B, 2A, 3B
Mud Creek	(S. 16, 21, 22, T. 62, R. 1E)	1B, 2A, 3B
Murmur Creek	(T. 61, R. 2W)	1B, 2A, 3B
Myhre's Creek	(S. 23, 26, T. 62, R. 3E)	1B, 2A, 3B
Nester Creek	(S. 4, 5, 6, T. 61; R. 1W; S. 1, T. 61, R. 2W)	1B, 2A, 3B
Nicadoo Creek	(S. 1, 12, T. 56, R. 8W; S. 6, T. 56, R. 7W; S. 36, T. 57 R. 8W)	1B, 2A, 3B
Nine Mile Creek	(S. 3, 4, 7, 9, 16, T. 58, R. 6W; S. 27, 33, 34, T. 59, R. 6W)	1B, 2A, 3B
Oliver Creek	(S. 1, T. 57, R. 8W; S. 23, 26, 35, 36, T. 58, R. 8W)	1B, 2A, 3B
Onion Creek	(S. 1, 2, 3, 4, 12, T. 59, R. 4W; S. 24, 25, 26, 35, T. 60, R. 4W)	1B, 2A, 3B
Palasade Creek	(S. 8, 16, 17, 18, 19, 20, 21, 22, T. 56, R. 7W)	1B, 2A, 3B
Pancake Creek	(T. 60, R. 4W, 5W)	1B, 2A, 3B
Pecore Creek	(T. 61, R. 4W)	1B, 2A, 3B
Pike Lake Creek	(S. 15, T. 61, R. 2W)	1B, 2A, 3B
Pine Mountain Creek	(S. 26, 27, T. 63, R. 1E)	1B, 2A, 3B
Pine River	(T. 64, R. 3E)	2B
Plouffs Creek	(S. 17, 18, T. 61, R. 4W; S. 2, 11, 13, 14, 15, T. 61, R. 5W; S. 26, 35, T. 62, R. 5W)	1B, 2A, 3B
Poplar River (except trout waters)	(T. 60, 61, R. 3W, 4W)	2B
Poplar River	(S. 3, 4, 5, 6, 9, 10, 15, 16, 20, 21, 28, 33, T. 60, R. 3W; S. 31, T. 61, R. 3W; S. 10, 14, 15, 22, 23, 25, 26, 36, T. 61, R. 4W)	1B, 2A, 3B

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

WATERS	REACH OR AREA INVOLVED OR LOCATION	CLASSIFICATION
	LAKE SUPERIOR BASIN	
	St. Louis River Watershed (No. 1)	
Streams		
Anderson Creek	(S. 14, 15, 22, 26, 27, T. 46, R. 17)	1B, 2A, 3B
Artichoke Creek	(S. 7, 8, 18, T. 52, R. 17)	1B, 2A, 3B
Athlenius Creek	(S. 9, 10, T. 53, R.14)	1B, 2A, 3B
First (Mud) Creek	(S. 3, 10, 11, T. 58, R. 15; S. 27, 34, T. 59, R. 15)	2A, 3B
Banner Brook	(S. 16, 21, T. 58, R. 13)	1B, 2A, 3B
Beartrap Creek	(S. 15, 16, 21, 22, 25, 26, 27, 28, T. 51, R. 17)	1B, 2A, 3B
Beaver River	(T. 52, R. 16, 17)	2B
Berry Creek	(S. 2, 10, 11, 12, 15, 21, 28, 29, 31, T. 56, R. 12; S. 6, 7, 18, 19, T. 55, R. 12; S. 12, 13, T. 55, R. 13)	1B, 2A, 3B
Blackhoof River	(S. 6, 7, 8, 10, 14, 15, 18, 19, 20, 22, 16, 17, 25, 26, 27, T. 47, R. 17; S. 30, 31, T. 48, R. 17; S. 26, 30, T. 47, R. 16)	1B, 2A, 3B
Boulder Creek	(T. 53, 54, R. 14)	2C
Bug Creek	(T. 54, R. 15, 16)	2B
Canutrup Creek	(S. 19, T. 46, R. 17)	2B
Carey Creek	(S. 28, 33, T. 53, R. 14)	1B, 2A, 3B
Chalberg Creek	(S. 1, 2, 3, 10, T. 51, R. 17)	1B, 2A, 3B
Clear Creek	(S. 6, T. 46, R. 16; S. 1, 10, 11, 12, 15, 16, 21, T. 46, R. 17)	1B, 2A, 3B
Cloquet River	(T. 51, 52, 53, 54, 55, R. 12, 13, 14, 15, 16, 17, 18)	2B
Little Cloquet River	(T. 53, 54, R. 12, 13)	2B
Cloquet River, West Branch	(R. 55, 56, R. 12, 13)	2B
Coolidge Creek	(S. 19, 20, 30, T. 55, R. 14; S. 25, 35, 36, T. 55, R. 15)	1B, 2A, 3B
Cranberry Creek	(T. 58, R. 13)	2C
Crystal Creek	(S. 6, T. 48, R. 16; S. 1, T. 48, R. 17; S. 36, T. 49, R. 17)	1B, 2A, 3B
Deer Creek	(S. 19, 20, 29, T. 47, R. 16; S. 12, 13, 24, T. 47, R. 17)	1B, 2A, 3B
Dutchess Slough Creek	(S. 9, 10, 13, 14, 15, 24, T. 50, R. 17)	1B, 2A, 3B
Elbow Creek	(T. 56, 57, R. 18)	2B
Embarrass River	(T. 59, 60, R. 13, 14, 15)	2B
Elm Creek	(S. 1, 2, T. 49, R. 16; S. 35, T. 50, R. 16)	1B, 2A, 3B
Floodwood River	(T. 52, 53, 54, R. 20, 21)	2B
Hay Creek	(S. 27, 28, 29, 32, 33, T. 50, R. 16; S. 3, 4, 9, 10, 15, T. 49, R. 16)	1B, 2A, 3B
Hellwig Creek	(S. 13, 14, 24, 25, 35, T. 53, R. 17; S. 3, 10, 14, 15, 23, 26, T. 52, R. 17)	1B, 2A, 3B

CHAPTER TWENTY-FOUR: WPC 24

CLASSIFICATIONS OF INTRASTATE WATERS OF MINNESOTA

WPC 24: The following regulation establishing classifications pertains to all intrastate surface waters of the state.

(a) All intrastate waters are included, although some minor watercourses such as unnamed streams or interconnecting waters and/or intermittently flowing creeks, ditches, or draws, etc., are not listed individually herein. All intrastate waters are classified herein and this classification shall supersede the classification of any intrastate waters given in Regulation WPC 1, 2, 5, 6, 7, 8, 9, 10, 16 and 17.

(b) All known present uses and/or uses which may be made of the waters in the future are included. In addition to the classification given below, all of the waters named herein are also included in classes 3C, 4A and B, 5 and 6, where such uses are possible. All other waters not specifically named herein shall be classified as 2B, 2C, 3B, 3C, 4A and B, 5 and 6 unless deletion of any one or all of such designations is recommended by the Minnesota Department of Natural Resources on the basis of information available as to its actual or potential suitability for the given uses. Where specific criteria are common to two or more listed classes the more restrictive value shall apply. For additional information refer to Regulation WPC 14, Criteria for the Classification of the Intrastate Waters of the State and the Establishment of Standards of Quality and Purity, and to Regulation WPC 23, Standards of Quality and Purity for Effluents Discharged to Intrastate Waters.

(c) Interstate waters are defined in the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.), Section 13(e) thereof as including all rivers, lakes, and other waters that flow across or form a part of state boundaries. All of the remaining designated waters of the state which do not meet the definition of interstate waters given above are to be construed herein as constituting intrastate waters.

(d) The provisions of this regulation shall be severable and the invalidity of any lettered paragraph or any subparagraph or subdivision thereof shall not make void any other lettered paragraph, subparagraph subdivision or any other part thereof.

d. The classification of surface waters as limited resource value waters pursuant to section B. 7. of this rule and 6 MCAR § 4.8025 shall not supercede, alter or replace the classification and designation of such waters as public waters pursuant to applicable provisions and requirements of Minn. Stat. ch. 105.

* All effluent limitations specified in section C. 6. shall also be applicable to dischargers to Class 7 waters, provided that unspecified toxic or corrosive substances shall be limited to the extent necessary to protect the designated uses of the receiving water or affected downstream waters.

** As measured by the arithmetic mean of all samples taken during any calendar month.

17. No person who is in compliance with the terms and conditions of its permit issued pursuant to 6 MCAR § 4.8036 shall be deemed in violation of any water quality standard in this rule for which a corresponding effluent limitation is established in the permit. However, exceedances of the water quality standards in a receiving water shall constitute grounds for modification of a permit(s) for any discharger(s) to the receiving water who is (are) causing or contributing to the exceedances. 6 MCAR § 4.8036 shall govern the modification of any such permit.

18. For the purpose of establishing limitations to meet the ammonia water quality standard, a statistic which estimates the central value (such as the mean or median) for ambient pH and temperature of the receiving water for the critical months shall be used.

D. Specific standards of quality and purity for designated classes of interstate waters of the state. The following standards shall prescribe the qualities or properties of the interstate waters of the state which are necessary for the designated public use or benefit and which, if the limiting conditions given are exceeded, shall be considered indicative of a polluted condition which is actually or potentially deleterious, harmful, detrimental or injurious with respect to such designated uses or established classes of the interstate waters:

1. Domestic consumption.

Class A–The quality of this class of the interstate waters of the state shall be such that without treatment of any kind the raw waters will meet in all respects both the mandatory and recommended requirements of the Public Health Service Drinking Water Standards-1962 for drinking water as specified in Publication No. 956 published by the Public Health Service of the U. S. Department of Health, Education and Welfare, and any revisions, amendments or supplements thereto. This standard will ordinarily be restricted to underground waters with a high degree of natural protection. The basic requirements are given below:

Substance or Characteristic	Limit or Range
Total coliform organisms	1 most probable number per 100 milliliters

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

Turbidity value	5
Color value	15
Threshold odor number	3
Methylene blue active substance (MBAS)	0.5 milligram per liter
Arsenic (As)	0.01 milligram per liter
Chlorides (Cl)	250 milligrams per liter
Copper (Cu)	1 milligram per liter
Carbon Chloroform extract	0.2 milligram per liter
Cyanides (CN)	0.01 milligram per liter
Fluorides (F)	1.5 milligrams per liter
Iron (Fe)	0.3 milligram per liter
Manganese (Mn)	0.05 milligram per liter
Nitrates (NO_3)	45 milligrams per liter
Phenol	0.001 milligram per liter
Sulfates (SO_4)	250 milligrams per liter
Total dissolved solids	500 milligrams per liter
Zinc (Zn)	5 milligrams per liter
Barium (Ba)	1 milligram per liter
Cadmium (Cd)	0.01 milligram per liter
Chromium (Hexavalent, Cr)	0.05 milligram per liter
Lead (Pb)	0.05 milligram per liter
Selenium (Se)	0.01 milligram per liter
Silver (Ag)	0.05 milligram per liter
Radioactive material	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

Class B–The quality of this class of the interstate waters of the state shall be such that with approved disinfection, such as simple chlorination or its equivalent, the treated water will meet in all respects both the mandatory and recommended requirements of the Public Health Service Drinking Water Standards-1962 for drinking water as specified in Publication No. 956 published by the Public Health Service of the U. S. Department of Health, Education and Welfare, and any revisions, amendments or supplements thereto. This standard will ordinarily be restricted to surface and underground waters with a moderately high degree of natural protection. The physical and chemical standards quoted above for Class A interstate waters shall also apply to these interstate waters in the untreated state.

Class C–The quality of this class of the interstate waters of the state shall be such that with treatment consisting of coagulation, sedimentation, filtration, storage and chlorination, or other equivalent treatment processes, the treated water will meet in all respects both the mandatory and recommended requirements of the Public Health Service Drinking Water Standards-1962 for drinking water as specified in Publication No. 956 published by the Public Health Service of the U. S. Department of Health, Education and Welfare, and any revisions, amendments or supplements thereto. This standard will ordinarily be restricted to surface waters, and ground waters in aquifers not considered to afford adequate protection against contamination from surface or other sources of pollution. Such aquifers normally would include fractured and channeled limestone, unprotected impervious hard rock where interstate water is obtained from mechanical fractures, joints, etc., with surface connections, and coarse gravels subjected to surface water infiltration. The physical and chemical standards quoted above for Class A interstate waters shall also apply to these interstate waters in the untreated state, except as listed below:

Substance or Characteristic	Limit or Range
Turbidity value	25

Class D—The quality of this class of the interstate waters of the state shall be such that after treatment consisting of coagulation, sedimentation, filtration, storage and chlorination, plus additional pre, post, or intermediate stages of treatment, or other equivalent treatment processes, the treated water will meet in all respects the recommended requirements of the Public Health Service *Drinking Water Standards-1962* for drinking water as specified in Publication No. 956 published by the Public Health Service of the U. S. Department of Health, Education and Welfare, and any revisions, amendments or supplements thereto. This standard will ordinarily be restricted to surface waters, and ground waters in aquifers not considered to afford adequate protection against contamination from surface or other sources of pollution. Such aquifers normally would include fractured and channeled limestone, unprotected impervious hard rock where water is obtained from mechanical fractures, joints, etc., with surface connections, and coarse gravels subjected to surface water infiltration. The concentrations or ranges given below shall not be exceeded in the raw waters before treatment:

Substance or Characteristic	Limit or Range
Arsenic (As)	0.05 milligram per liter
Barium (Ba)	1 milligram per liter
Cadmium (Cd)	0.01 milligram per liter
Chromium (Cr + 6)	0.05 milligram per liter
Cyanide (CN)	0.2 milligram per liter
Fluoride (F)	1.5 milligrams per liter
Lead (Pb)	0.05 milligram per liter
Selenium (Se)	0.01 milligram per liter
Silver (Ag)	0.05 milligram per liter
Radioactive Material	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

In addition to the above listed standards, no sewage, industrial waste or other wastes, treated or untreated, shall be discharged into or permitted by any person to gain access to any interstate waters classified for domestic consumption so as to cause any material undesirable increase in the taste, hardness, temperature, toxicity, corrosiveness or nutrient content, or in any other manner to impair the natural quality or value of the interstate waters for use as a source of drinking water.

2. Fisheries and recreation.

Class A–The quality of this class of the interstate waters of the state shall be such as to permit the propagation and maintenance of warm or cold water sport or commercial fishes and be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. Limiting concentrations or ranges of substances or characteristics which should not be exceeded in the interstate waters are given below:

Substance or Characteristic	Limit or Range
Dissolved oxygen	Not less than 7 milligrams per liter at all times (instantaneous minimum concentration)***
Temperature	No material increase
Ammonia (N)*	0.016 milligram per liter (un-ionized as N)
Chlorides (Cl)	50 milligrams per liter
Chromium (Cr)	0.02 milligram per liter
Copper (Cu)	0.01 milligram per liter or not greater than 1/10 the 96 hour TLM value.
Cyanides (CN)	0.02 milligrams per liter
Oil	0.5 milligram per liter
pH value	6.5 - 8.5
Phenols	0.01 milligram per liter and none that could impart odor or taste to fish flesh or other fresh-water edible products such as crayfish, clams, prawns and like creatures. Where it seems probable that a discharge may result in tainting of edible aquatic products, bioassays and taste panels will be required to determine whether tainting is likely or present.
Turbidity value	10
Color value	30
Fecal coliform organisms	200 organisms per 100 milliliters as a logarithmic mean measured in not less than five samples in any calendar month, nor shall more than 10% of all samples

Fecal coliform organisms (cont.)	taken during any calendar month individually exceed 400 organisms per 100 milliliters. (Applies only between March 1 and October 31.)
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.
Total Residual Chlorine**	0.005 milligrams per liter

* The percent un-ionized ammonia can be calculated for any temperature and pH by using the following formula taken from Thurston, R. V., R. C. Russo, and K. Emerson, 1974. Aqueous ammonia equilibrium calculations. Technical Report Number 74-1, Fisheries Bioassay Laboratory, Montana State University, Bozeman, MT. 18 p.

$$f = \frac{1}{10^{(pk_a - pH)} + 1} \times 100$$

where:

f = the percent of total ammonia in the un-ionized state

$pk_a = 0.0901821 + \frac{2729.92}{T}$, dissociation constant for ammonia

T = temperature in degrees Kelvin (273.16° Kelvin = 0° Celsius)

** Applies to conditions of continuous exposure, where continuous exposure refers to chlorinated effluents which are discharged for more than a total of two hours in any 24 hour period.

*** This dissolved oxygen standard shall be construed to require compliance with the standard 50 percent of the days at which the flow of the receiving water is equal to the lowest weekly flow with a once in ten year recurrence interval (7Q10).

Class B–The quality of this class of the interstate waters of the state shall be such as to permit the propagation and maintenance of cool or warm water sport or commercial fishes and be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. Limiting concentrations or ranges of substances or characteristics which should not be exceeded in the interstate waters are given below:

Substance or Characteristic	Limit or Range
Dissolved oxygen****	Not less than 5 milligrams per liter at all times (instantaneous minimum concentration)*****

Temperature*	$5^{o}F$ above natural in streams and $3^{o}F$ above natural in lakes, based on monthly average of the maximum daily temperature, except in no case shall it exceed the daily average temperature of $86^{o}F$.
Ammonia (N)**	0.04 milligram per liter (un-ionized as N)
Chromium (Cr)	0.05 milligram per liter
Copper (Cu)	0.01 milligram per liter or not greater than 1/10 the 96 hour TLM value.
Cyanides (CN)	0.02 milligram per liter
Oil	0.5 milligram per liter
pH value	6.5 - 9.0
Phenols	0.01 milligram per liter and none that could impart odor or taste to fish flesh or other fresh-water edible products such as crayfish, clams, prawns and like creatures. Where it seems probable that a discharge may result in tainting of edible aquatic products, bio-assays and taste panels will be required to determine whether tainting is likely or present.
Turbidity value	25
Fecal coliform organisms	200 organisms per 100 milliliters as a logarithmic mean measured in not less than five samples in any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. (Applies only between March 1 and October 31.)
Radioactive materials	Not to exceed the lowest concentration permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.
Total Residual Chlorine***	0.005 milligrams per liter

* The following temperature criteria will be applicable for the Mississippi River from Lake Itasca to the outlet of the Metro Wastewater Treatment Works in St. Paul in addition to or superseding the above. The

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

weekly average temperature shall not exceed the following temperatures during the specified months:

January	40°F	July	83°F
February	40°F	August	83°F
March	48°F	September	78°F
April	60°F	October	68°F
May	72°F	November	50°F
June	78°F	December	40°F

For the Mississippi River from Lock and Dam No. 2 at Hastings to the Iowa Border, the weekly average temperature shall not exceed the following temperatures during the specified months:

January	40°F	July	84°F
February	40°F	August	84°F
March	54°F	September	82°F
April	65°F	October	73°F
May	75°F	November	58°F
June	84°F	December	48°F

** See ammonia footnote for Class 2A waters.

*** See chlorine footnote for Class 2A waters.

**** This standard shall apply to all interstate waters of the state except for the reach of the Mississippi River from the outlet of the Metro wastewater treatment works in St. Paul (River Mile 835) to Lock and and Dam No. 2 at Hastings (River Mile 815). For this reach of the Mississippi River the standard shall be not less than 5 milligrams per liter from April 1 through November 30, and not less than 4 milligrams per liter at other times.

***** See dissolved oxygen footnote for Class 2A waters.

Class C–The quality of this class of the interstate waters of the state shall be such as to permit the propagation and maintenance of rough fish or species commonly inhabiting waters of the vicinity under natural conditions, and be suitable for boating and other forms of aquatic recreation for which the interstate waters may be usable. Limiting concentrations or ranges of substances or characteristics which should not be exceeded in the interstate waters are given below:

Substance or Characteristic	Limit or Range
Dissolved oxygen****	Not less than 5 milligrams per liter at all times (instantaneous minimum concentration)*****
Temperature*	5°F above natural in streams and

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

Temperature* (cont.)	3°F above natural in lakes, based on monthly average of the maximum daily temperature except in no case shall it exceed the daily average temperature of 90°F.
Ammonia (N)**	0.04 milligram per liter (un-ionized as N)
Chromium (Cr)	0.05 milligram per liter
Copper (Cu)	0.01 milligram per liter or not greater than 1/10 the 96 hour TLM value.
Cyanides (CN)	0.02 milligram per liter
Oil	10 milligrams per liter, and none in such quantities as to (1) produce a visible color film on the surface, (2) impart an oil odor to water or an oil taste to fish and edible invertebrates, (3) coat the banks and bottom of the watercourse or taint any of the associated biota, or (4) become effective toxicants according to the criteria recommended.
pH value	*6.5 - 9.0*
Phenols	0.1 milligram per liter and none that could impart odor or taste to fish flesh or other fresh-water edible products such as crayfish, clams, prawns and like creatures. Where it seems probable that a discharge may result in tainting of edible aquatic products, bioassays and taste panels will be required to determine whether tainting is likely or present.
Turbidity value	25
Fecal coliform organisms	200 organisms per 100 milliliters as a logarithmic mean measured in not less than five samples in any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. (Applies only between March 1 and October 31.)
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

Radioactive materials (cont.)	environment as prescribed by the appropriate authority having control over their use.
Total Residual Chlorine***	0.005 milligrams per liter.

*The following temperature criteria will be applicable for the Mississippi River from the outlet of the Metro Wastewater Treatment Works in St. Paul to Lock and Dam No. 2 at Hastings in addition to or superseding the above. The weekly average temperature shall not exceed the following temperatures during the specified months.

January	40°F	July	83°F
February	40°F	August	83°F
March	48°F	September	78°F
April	60°F	October	68°F
May	72°F	November	50°F
June	78°F	December	40°F

** See Ammonia footnote for Class 2A waters.

*** See Chlorine footnote for Class 2A waters.

**** This standard shall apply to all interstate waters of the state except for the reach of the Mississippi River from outlet of the Metro wastewater treatment works in St. Paul (River Mile 835) to Lock and Dam No. 2 at Hastings (River Mile 815). For this reach of the Mississippi River the standard shall be not less than 5 milligrams per liter from April 1 through November 30, and not less than 4 milligrams per liter at other times.

***** See dissolved oxygen footnote for Class 2A waters.

For all classes of fisheries and recreation waters, the aquatic habitat, which includes the interstate waters and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste or other waste effluents to the interstate waters.

No sewage, industrial waste or other wastes shall be discharged into any of the interstate waters of this category so as to cause any material change in any other substances or characteristics which may impair the quality of the interstate waters or the aquatic biota of any of the above listed classes or in any manner render them unsuitable or objectionable for fishing, fish culture or recreational uses. Additional selective limits or changes in the discharge bases may be imposed on the basis of local needs.

3. Industrial consumption.

Class A—The quality of this class of the interstate waters of the state shall be such as to permit their use without chemical treatment, except softening for ground water, for most industrial purposes, except food processing and related uses, for which a high quality of water is required. The quality shall be generally comparable to Class B waters for domestic consumption, except for the following:

Substance or Characteristic	Limit or Range
Chlorides (Cl)	50 milligrams per liter
Hardness	50 milligrams per liter
pH value	6.5 - 8.5

Class B—The quality of this class of the interstate waters of the state shall be such as to permit their use for general industrial purposes, except for food processing, with only a moderate degree of treatment. The quality shall be generally comparable to Class D interstate waters used for domestic consumption, except the following:

Substance or Characteristic	Limit or Range
Chlorides (Cl)	100 milligrams per liter
Hardness	250 milligrams per liter
pH value	6.0 - 9.0

Class C—The quality of this class of the interstate waters of the state shall be such as to permit their use for industrial cooling and materials transport without a high degree of treatment being necessary to avoid severe fouling, corrosion, scaling, or other unsatisfactory conditions. The following shall not be exceeded in the interstate waters:

Substance or Characteristic	Limit or Range
Chlorides (Cl)	250 milligrams per liter
Hardness	500 milligrams per liter
pH value	6.0 - 9.0

Additional selective limits may be imposed for any specific interstate waters as needed.

In addition to the above listed standards, no sewage, industrial waste or other wastes, treated or untreated, shall be discharged into or permitted by any person to gain access to any interstate waters classified for industrial purposes so as to cause any material impairment of their use as a source of industrial water supply.

4. Agriculture and wildlife.

Class A—The quality of this class of the interstate waters of the state shall be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area, including truck garden crops. The following concentrations or limits shall be used as a guide in determining the suitability of the waters for such uses, together with the recommendations contained in Handbook 60 published by the Salinity Laboratory of the U. S. Department of Agriculture, and any revisions, amendments or supplements thereto:

Substance or Characteristic	Limit or Range
Bicarbonates (HCO_3)	5 milliequivalents per liter
Boron (B)	0.5 milligram per liter
pH value	6.0 - 8.5
Specific conductance	1,000 micromhos per centimeter
Total dissolved salts	700 milligrams per liter
Sodium (Na)	60% of total cations as milliequivalents per liter
Sulfates (SO_4)	10 milligrams per liter, applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels.
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

Class B—The quality of this class of the interstate waters of the state shall be such as to permit their use by livestock and wildlife without inhibition or injurious effects. The limits or concentrations of substances or characteristics given below shall not be exceeded in the interstate waters:

Substance or Characteristic	Limit or Range
pH value	6.0 - 9.0
Total salinity	1,000 milligrams per liter
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.
Unspecified toxic substances	None at levels harmful either directly or indirectly.

Additional selective limits may be imposed for any specific interstate waters as needed.

5. Navigation and waste disposal. The quality of this class of the inter-

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

state waters of the state shall be such as to be suitable for esthetic enjoyment of scenery and to avoid any interference with navigation or damaging effects on property. The following limits or concentrations shall not be exceeded in the interstate waters:

Substance or Characteristic	Limit or Range
pH value	6.0 - 9.0
Hydrogen sulfide	0.02 milligrams per liter

Additional selective limits may be imposed for any specific interstate waters as needed.

6. Other uses. The uses to be protected in this class may be under other jurisdictions and in other areas to which the interstate waters of the state are tributary, and may include any or all of the uses listed in the foregoing categories, plus any other possible beneficial uses. The agency therefore reserves the right to impose any standards necessary for the protection of this class, consistent with legal limitations.

7. Limited resource value waters. The quality of this class of interstate waters shall be such as to protect aesthetic qualities, secondary body contact use, and ground water for use as a potable water supply. The limits or concentrations of substances or characteristics given below shall not be exceeded in the interstate waters:

Substance or Characteristic	Limit or Range
Fecal Coliform Organisms	1,000 organisms per 100 milliliters* (Applies only between May 1 and October 31)
pH	6.0 - 9.0
Dissolved Oxygen	At concentrations which will avoid odors, or putrid conditions in the receiving water or at concentrations at not less than 1 mg/l (daily average) provided that measurable concentrations are present at all times.
Unspecified Substances	Unspecified substances shall not be allowed in such quantities or concentrations that will impair the specified uses.

* The stated value is not to be exceeded in any calendar month as determined by the logarithmic mean of a minimum of 5 samples, nor shall more than 10% of all samples taken during any calendar month individually exceed 2,000 organisms per 100 milliliters.

TABLE C.1 (Cont'd)

WATER QUALITY STREAM CLASSIFICATIONS AND STANDARDS

Pollution Control Agency

6 MCAR § 4.8025 Classifications of interstate waters of Minnesota. The following rule establishing classifications applies to all interstate surface waters of the state.

A. All interstate waters are included, although some minor watercourses such as unnamed streams or interconnecting waters and/or intermittently flowing creeks, ditches, or draws, etc., are not listed individually herein. All interstate waters are classified herein and this classification shall supersede the classification of the interstate waters listed in previously adopted WPC 1.

B. The rule includes known present uses and/or uses which may be made of the waters in the future. In addition to the classification(s) given below, all of the interstate waters whether or not specifically named herein are also included in Classes 2C, 3C, 4A and B, 5 and 6 for all reaches or areas where such uses are possible, provided that waters specifically classified as limited resource value shall only be included in the following additional classes: 3C, 4A, 4B, 5 and 6. Where specific criteria are common to two or more listed classes the more restrictive value shall apply. For additional information refer to 6 MCAR § 4.8015, Criteria for the classification of the interstate waters of the state and the establishment of standards of quality and purity.

C. The provisions of this rule shall be severable and the invalidity of any lettered paragraph or any subparagraph or subdivision thereof shall not make void any other lettered paragraph, subparagraph, subdivision or any other party thereof.

D. Supplement 1 to this rule lists interstate waters that are classified as limited resource value waters, Class 7. For those interstate waters identified with an asterisk (*), the revised classification in Supplement 1 shall supersede any previous classification; provided, however, that the limited resource value classification shall apply only to that portion of the water specifically described in Supplement 1.

TABLE C.2

DULUTH IAP SURFACE WATER SAMPLING POINT ANALYTICAL RESULTS
TYPICAL RANGE OF VALUES

Parameter	Units	Sample Points								
		1	2	3	4	5	6	7	8	9
Oil & Grease	mg/l	<0.3-0.4	0.4	<0.3-0.3	79-230	4.6-67.6	<0.3	<0.3-3.2	0.3	<0.3-7.02
Ammonia as N	mg/l	0.2	0.2	0.4	6.8-7.4	<0.0-12.5	0.7-1.4	<0.1-0.6	0.6-0.8	<.1-1.0
Nitrate as N	mg/l	0.1	<0.1	<0.1	<0.1-0.4	<0.0-0.51	0.8-0.9	<0.1-3	0.1-0.302	<.1-6.0
Nitrite as N	mg/l	0.2	<0.02	<0.02	<0.02	<0.0-0.2	<0.02	0.02-<0.2	<0.02	<0.02-0.02
TKN as N	mg/l	<1	<1.0	<1.0	20-37	<0.0-25	1.2-1.3	<0.1-2.4	<1.0-1.0	<1-1
Phosphorus	mg/l	<0.1	<0.1	.022	4.5-6	<0.0-17	0.027-0.2	0.083-<0.2	<0.1-0.104	0.050-<0.2
Cyanide	mg/l	—	—	—	<0.01	<0.01-0.1	<0.01	0.01-<0.1	<0.01	0.08-<1.0
Phenols	µg/l	—	—	—	<0.001	26-32	<10-14	<.001-<10	<10	<10-40
Cadmium	µg/l	—	—	—	—	—	—	—	—	0.01
Chromium	µg/l	—	—	<0.05	—	<50-165	<5-<50	<.05-<50	<5-<50	<5-<50
Copper	µg/l	—	—	0.2	—	52-71	12-35	<0.02-0.04	6-28	6.0-269
Iron	mg/l	—	—	—	—	—	—	—	—	0.6.9-3.5
Lead	µg/l	—	—	<0.05	—	<5-50	<5-<50	<0.05	<5 -<50	--
Manganese	µg/l	—	—	0.5	—	211-310	1380-3431	0.55-670	153	32-700
Mercury	µg/l	—	—	0.005	—	2.2-<5	3-<5	<0.005-<5	2.5-<5	3.4-<5
Nickel	mg/l	—	—	—	—	—	—	—	—	0.05
Silver	mg/l	—	—	—	—	—	—	—	—	0.01
Zinc	µg/l	—	—	<0.05	—	217-331	36-87	<.05-<50	23-<50	18-<50

TABLE C.2 (CONTINUED)

Parameter	Units	1	2	3	4	5	6	7	8	9
Chloride	mg/l	40-48.4	20	46.9	36-47.4	27.1-32	427-1000	22.4	8.7-16	10.2-12
Color	mg/l	40-50	60	40	30-60	30-40	20-30	100-175	40-80	40-80
Fluoride	mg/l	0.1-0.16	<0.1	0.23	1.18-1.8	0.7-1.1	<0.1-0.1	0.1-0.36	0.1-0.23	0.1-0.33
Aldrin	mg/l	—	—	—	—	—	ND	ND	ND	ND
Chlordane	mg/l	—	—	—	—	—	ND	ND	ND	ND-0.61
DDT, Isomers	mg/l	—	—	—	—	—	ND	ND	ND	ND
Dieldrin	mg/l	—	—	—	—	—	ND	ND	ND	ND
Endrin	mg/l	—	—	—	—	—	ND	ND	ND	ND
Heptachlor	mg/l	—	—	—	—	—	ND	ND	ND	ND
Baygon	µg/l	<400	—	<200	—	<0.0-2000	ND-<400	<0.0-<400	<200	<0.0-400
Malathion	µg/l	<100	—	<100	—	140	<0.0-140	<0.0-<100	<100	<0.0-100
Heptachloroepoxide	µg/l	—	—	—	—	ND	ND	ND	ND	ND
Lindane	µg/l	—	—	—	—	<0.0-<10	ND	<0.0-<10	ND	<0.0-<10
Methoxychlor	µg/l	—	—	—	—	—	ND	ND	ND	ND
Toxaphene	µg/l	—	—	—	—	—	ND	ND	ND	ND
2,4-D	µg/l	<60.0	—	<60.0	—	130	<60	200	<60	<60
2,4,5-TP Silvex	µg/l	<60.0	—	<60.0	—	320	<60	<600	<60	<60
Diazinon	µg/l	35.0	—	27	—	—	81	<0.0-200	24	<0.0-26

Notes: (1) Sample points are illustrated in Figure 3.6.

(2) ND: None Detected

APPENDIX D

MASTER LISTS OF INDUSTRIAL SHOPS AND LABORATORIES

TABLE D.1
MASTER LISTS OF INDUSTRIAL SHOPS AND LABORATORIES

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes[1]	Past On-site Treatment, Storage and Disposal Activities[2]
4787 Air Base Group (ABG)					
Ceramic Hobby Shop	315	none recorded[3]			
Data Automation	385	none recorded	X		
Commissary	311	previously located in Bldg. 206			
Auto Hobby Shop	315	none recorded	X	X	Contract disposal
23rd Air Division					
CEMIRT	306	none recorded	X	X	Evaporation to sanitary sewer, drummed to DPDO
SAGE/Power Production	240	none recorded	X	X	Drummed to DPDO, burned
Civil Engineering					
Carpentry Shop	313	none recorded			
Entomology	322	none recorded	X	X	To sanitary sewer, to landfill, to storage
Fire Department	303	none recorded	X		
Heating Plant	217	none recorded	X	X	Drummed to DPDO

(1) Hazardous waste acccording to CERCLA or a potentially hazardous waste (one which was suspected of being RCRA hazardous although insufficient data was available to fully characterize the waste).
(2) Past treatment, storage, and/or disposal activities - present activities are covered under RCRA.
(3) None recorded indicates that available records or documentation indicated no past building locations existed.

TABLE D.1
(Continued)
MASTER LISTS OF INDUSTRIAL SHOPS AND LABORATORIES

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes(1)	Past On-site Treatment, Storage and Disposal Activities(2)
Civil Engineering (Continued)					
Paint Shop	339	none recorded	X	X	Drummed to DPDO
Battery/Power Production Shop	326	none recorded	X	X	Neutralization, drummed to DPDO
Sheet Metal and Welding Shop	325	none recorded	X		
Electric Shop	325	none recorded			
Heating maintenance	325	none recorded			
Housing maintenance	325	none recorded	X		
Roads and Grounds	103	located in 342 until 1981	X	X	Drummed to DPDO
Plumbing	325	none recorded			
Refrigeration and A/C	103	located in 343 until 1981	X		
Materials Squadron (MATS)					
AGE/Tire shop	103	none recorded	X	X	Drummed to DPDO
Fuel Test Lab/POL	126	none recorded	X	X	To Fire Dept. for burning, to sanitary sewer
Packing and Crating	314	none recorded			
Vehicle Maintenance	318	none recorded	X	X	Drummed to contractor, drummed to DPDO
Paint Shop	103	none recorded	X	X	Drummed to DPDO

(1) Hazardous waste acccording to CERCLA or a potentially hazardous waste (one which was suspected of being RCRA hazardous although insufficient data was available to fully characterize the waste).
(2) Past treatment, storage, and/or disposal activities - present activities are covered under RCRA.
(3) None recorded indicates that available records or documentation indicated no past building locations existed.

TABLE D.1
(Continued)
MASTER LISTS OF INDUSTRIAL SHOPS AND LABORATORIES

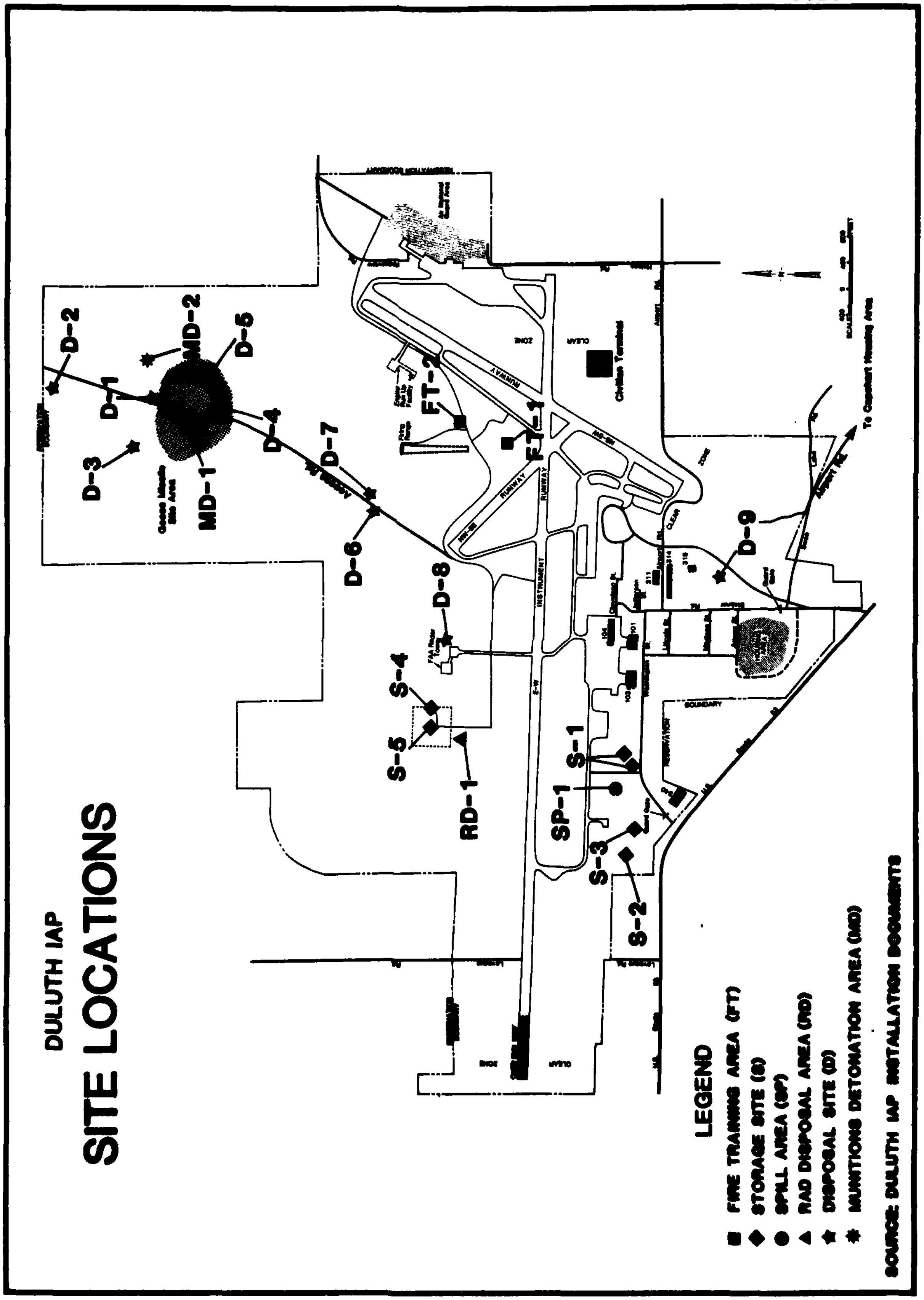
Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes(1)	Past On-site Treatment, Storage and Disposal Activities(2)
Material Squadron (MATS) (Continued)					
Welding Shop	318	none recorded	X	X	Neutralization
Battery Shop	318	none recorded	X	X	Storage, contract disposal
Refueling Maintenance	319	none recorded			
PMEL	304	none recorded	X		
Egress	103	none recorded			
Transient Alert	105	none recorded	X		
Battery/Electric shop	103	none recorded	X	X	Neutralization, sanitary sewer
Machine/Structural Repair	103	none recorded	X	X	To sanitary sewer
USAF Clinic					
Medical Lab	216	none recorded	X		
Medical X-ray	216	none recorded	X	X	Sanitary sewer, silver recovery
Dental Clinic	216	none recorded			
Dental Lab	216	none recorded	X		
Dental X-ray	216	none recorded	X	X	Sanitary sewer, silver recovery
DPDO	125	none recorded	X		

(1) Hazardous waste acccording to CERCLA or a potentially hazardous waste (one which was suspected of being RCRA hazardous although insufficient data was available to fully characterize the waste).
(2) Past treatment, storage, and/or disposal activities - present activities are covered under RCRA.
(3) None recorded indicates that available records or documentation indicated no past building locations existed.

APPENDIX E

SITE LOCATION MAP

FIGURE E.1

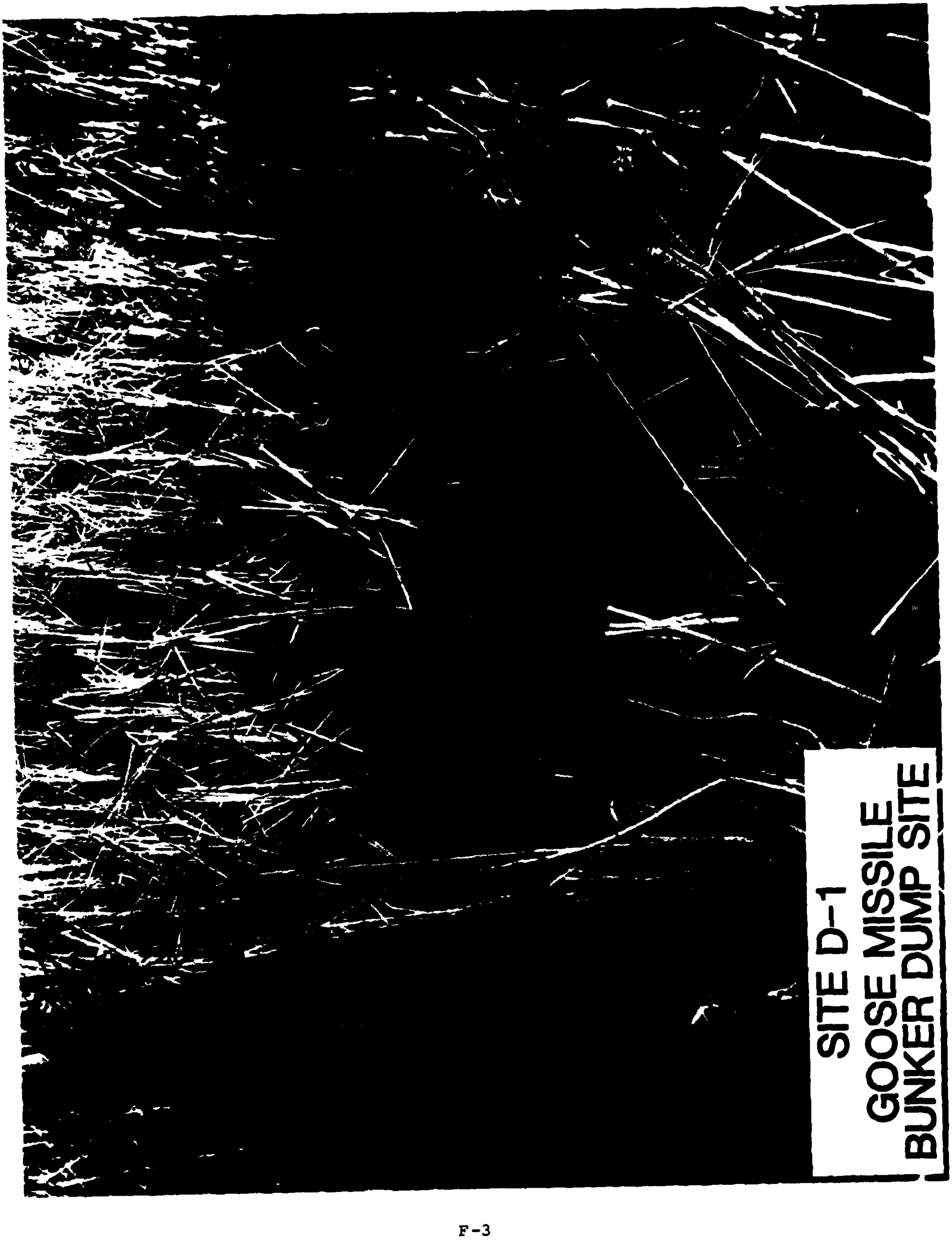

DULUTH IAP
SITE LOCATIONS
D-1
D-2
D-3
D-4
D-5
D-6
D-7
D-8
D-9
MD-1
MD-2
FT-1
FT-2
S-1
S-2
S-3
S-4
S-5
SP-1
RD-1
Civilian Terminal
INSTRUMENT
RUNWAY
E-W
CLEAR
ZONE
BOUNDARY
RESERVATION
LEGEND
FIRE TRAINING AREA (FT)
STORAGE SITE (S)
SPILL AREA (SP)
RAD DISPOSAL AREA (RD)
DISPOSAL SITE (D)
MUNITIONS DETONATION AREA (MD)
SOURCE: DULUTH IAP INSTALLATION DOCUMENTS

APPENDIX F

DULUTH IAP PHOTOGRAPHS

FIGURE F-2

FIGURE F-3



APPENDIX G

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

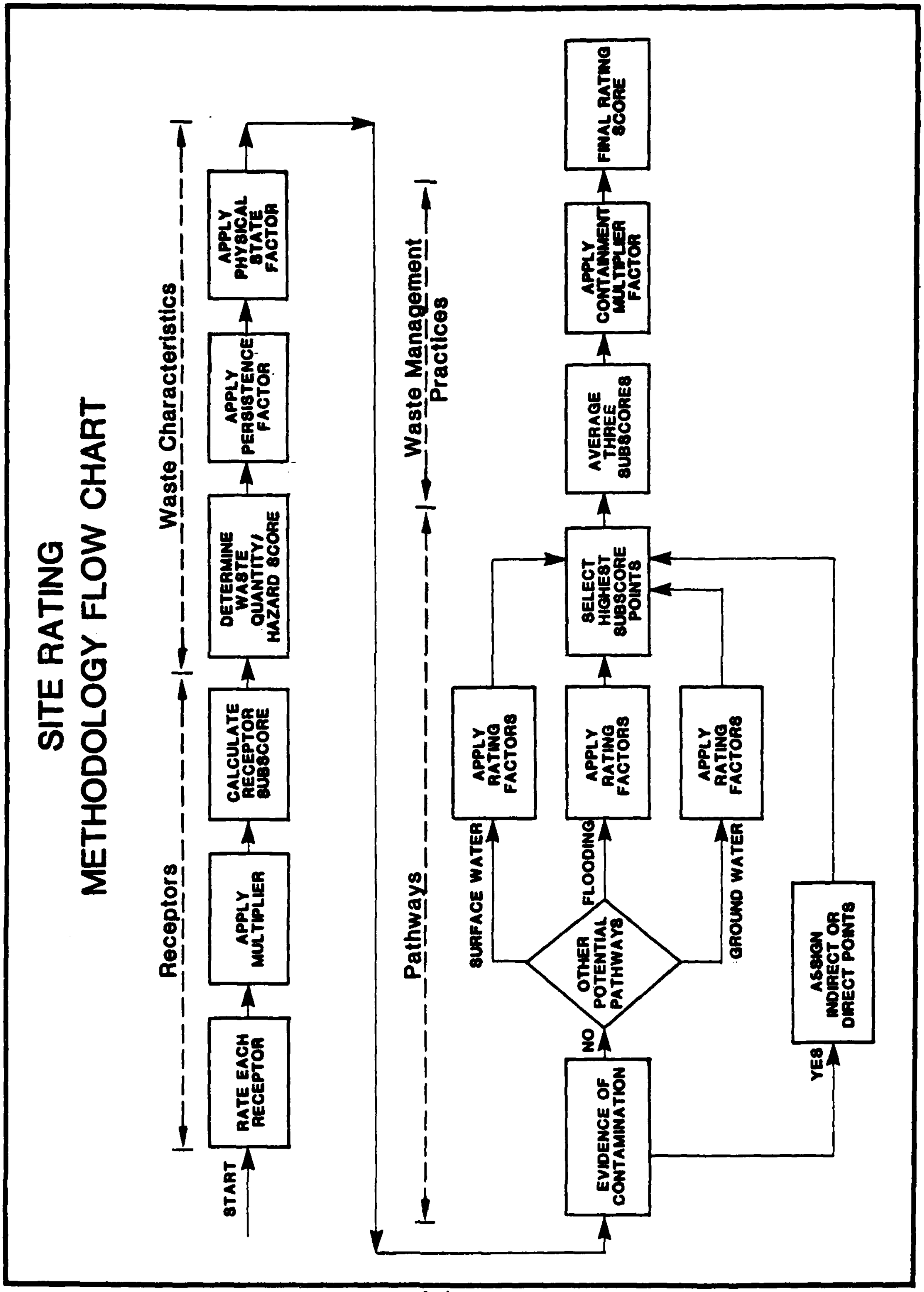
The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste managment practices category factor to the sum of the scores for the other three categories.

FIGURE 1



SITE RATING METHODOLOGY FLOW CHART

FIGURE 2

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		

Subtotals ______ ______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		

Subtotals ______ ______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ x ______ = ______

TABLE 1

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	6
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	3
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

	Rating Scale Levels				
Rating Factor	0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- Clay cap or other impermeable cover
- Leachate collection system
- Liners in good condition
- Adequate monitoring wells

Surface Impoundments:

- Liners in good condition
- Sound dikes and adequate freeboard
- Adequate monitoring wells

Spills:

- Quick spill cleanup action taken
- Contaminated soil removed
- Soil and/or water samples confirm total cleanup of the spill

Fire Proection Training Areas:

- Concrete surface and berms
- Oil/water separator for pretreatment of runoff
- Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX H

SITE HAZARDOUS ASSESSMENT RATING FORMS

APPENDIX H

TABLE OF CONTENTS

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE D-1 GOOSE MISSILE SITE

LOCATION

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	15
I. Population served by ground-water supply within 3 miles of site	1	6	6	15
Subtotals			69	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 38

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x 1 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	3	8	24	24
Direct access to ground water	3	8	24	24
Subtotals			108	114

Subscore (100 x factor score subtotal/maximum score subtotal) 95

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 95

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 38
Waste Characteristics 60
Pathways 95

Total 193 divided by 3 = 64 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

64 x 1 = $\boxed{64}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE FT-2

LOCATION NORTH OF MAIN RUNWAY, NORTH OF BYPASS ROAD.

DATE OF OPERATION OR OCCURRENCE EARLY 1960'S TO PRESENT

OWNER/OPERATOR FIRE DEPARTMENT

COMMENTS/DESCRIPTION FIRE CONTROL TRAINING EXERCISES

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			87	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 48

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x 1 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			84	114

Subscore (100 x factor score subtotal/maximum score subtotal) 74

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	48
Waste Characteristics	60
Pathways	80

Total 188 divided by 3 = 63 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

63 x 1 = $\boxed{63}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE FT - 1

LOCATION NORTH OF MAIN RUNWAY, SOUTH OF BYPASS ROAD.

DATE OF OPERATION OR OCCURRENCE 1951 TO EARLY 1960'S.

OWNER/OPERATOR FIRE DEPARTMENT

COMMENTS/DESCRIPTION FIRE CONTROL TRAINING EXERCISES.

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	67	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 37

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x 1 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	60	114

Subscore (100 x factor score subtotal/maximum score subtotal) 53

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 37
Waste Characteristics 60
Pathways 80

Total 177 divided by 3 = 59
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

59 x 0.95 = 56

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE S-2 DPDO STORAGE AREA "C"

LOCATION

DATE OF OPERATION OR OCCURRENCE 1965 TO 1982

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	97	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 54

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

30 x 1 = 30

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

30 x 1 = 30

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

2. Flooding

Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 81

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 81

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 54
Waste Characteristics 30
Pathways 81

Total 165 divided by 3 = 55
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

55 x 1 = $\boxed{55}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE SP-1 TANK FARM AREA

LOCATION

DATE OF OPERATION OR OCCURRENCE 1980'S

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	71	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 39

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

50 x 0.8 = 40

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

40 x 1 = 40

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 81

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 81

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	39
Waste Characteristics	40
Pathways	81
Total 160 divided by 3 =	53 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

53 x 1 = 53

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE D-4 SOUTH GOOSE MISSILE BUNKER DUMP

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	69	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 38

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

20 x 0.8 = 16

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

16 x 1 = 16

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			52	108

Subscore (100 X factor score subtotal/maximum score subtotal) 48

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	0

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	3	8	24	24
Direct access to ground water	3	8	24	24
Subtotals			108	114

Subscore (100 x factor score subtotal/maximum score subtotal) 95

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 95

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	38
Waste Characteristics	16
Pathways	95

Total 149 divided by 3 = 50 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

50 x 1 = 50

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE D-2 GOOSE MISSILE SITE DUMP.

LOCATION

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	75	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 42

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

30 x 0.8 = 24

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

24 x 1 = 24

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	2	8	16	24
Subtotals			84	114

Subscore (100 x factor score subtotal/maximum score subtotal) 74

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	42
Waste Characteristics	24
Pathways	80

Total 146 divided by 3 = 49 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

49 x 1 = 49

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE D-6 RUNWAY 13 N.E. DISPOSAL AREA

LOCATION

DATE OF OPERATION OR OCCURRENCE 1950'S TO 1970'S

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	75	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 42

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

30 x 0.9 = 27

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

27 x 1 = 27

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 81

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 81

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	42
Waste Characteristics	27
Pathways	81

Total 150 divided by 3 = 50 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

50 x 0.95 = $\boxed{48}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE S-1 OLD DPDO STORAGE AREA

LOCATION

DATE OF OPERATION OR OCCURRENCE 1950 TO 1964

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	83	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 46

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

30 x 0.8 = 24

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

24 x 1 = 24

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			84	114

Subscore (100 x factor score subtotal/maximum score subtotal) 74

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 74

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 46
Waste Characteristics 24
Pathways 74

Total 144 divided by 3 = 48
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

48 x 1 = $\boxed{48}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE D-9 DISPOSAL PIT

LOCATION

DATE OF OPERATION OR OCCURRENCE MID 1960'S

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	83	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 46

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

30 x 0.4 = 12

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

12 x 1 = 12

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	84	114

Subscore (100 x factor score subtotal/maximum score subtotal) 74

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 46
Waste Characteristics 12
Pathways 80

Total 138 divided by 3 = 46
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

46 x 0.95 = 44

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE RD-1 LOW LEVEL RADIOACTIVE WASTE DISPOSAL

LOCATION

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR

COMMENTS/DESCRIPTION

SITE RATED BY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
		Subtotals	85	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 47

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

20 x 1 = 20

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

20 x 0.50 = 10

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 81

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 81

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	47
Waste Characteristics	10
Pathways	81
Total 138 divided by 3 =	46 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

46 x 0.95 = 44

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ADC: Air Defense Command

AF: Air Force

AFB: Air Force Base

AFESC: Air Force Engineering and Services Center

AFFF: Aqueous Film Forming Foam - Fire Control Agent

AFR: Air Force Regulation

AGE: Aerospace Ground Equipment

ALLUVIUM: Unconsolidated sediments deposited in relatively recent geologic time by the action of running water

ANG: Air National Guard

ARGILLACEOUS: Composed of clay minerals or clay-sized particles

ARTESIAN: Ground water contained under hydrostatic pressure

AQUICLUDE: Poorly permeable formation that impedes ground-water movement and does not yield water to a well or spring

ARENACEOUS: Sand-bearing or sandy; containing sand-sized particles

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring

AVGAS: Aviation Gasoline

BEE: Bioenvironmental Engineering

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals

CB: Chlorobromomethane

CE: Civil Engineering

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act

CEMIRT: Civil Engineering Maintenance Inspection and Repair Team

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water

CONFINED AQUIFER: An aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability than that of the aquifer itself

CONSOLIDATED UNIT: Typically, igneous, metamorphic sedimentary earthen materials.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water

D: Disposal site

DDD: 2,2 - bis- (p-Chlorophenyl) - 1,1-dichloro-ethane; a degradation product of DDT.

DDE: 1,1 - dichloro - 2,2-bis (p-Chlorophenyl) ethylene; a degradation product of DDT.

Det: Detachment

DDT: 1,1,1 - Trichloro - 2,2,-bis (p-chlorophenyl) - ethane; a pesticide

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water

D.O.: Dissolved Oxygen

DOD: Department of Defense

DOWNGRADIENT: In the direction of lower hydraulic head; the direction in which ground water flows

DPDO: Defense Property Disposal Office

Duluth IAP: Duluth International Airport

Duluth MAP: Duluth Municipal Airport

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease, vectors and scavengers

EADC: Eastern Air Defense Command

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment

EOD: Explosive Ordnance Disposal

EPA: Environmental Protection Agency

EROSION: The wearing away of land surface by wind or water

ES: Engineering-Science, Inc.

FACILITY: Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year

FLOW PATH: The direction or movement of ground water and any contaminants that may be contained therein, as governed principally by the hydraulic gradient

FT: Fire Training

GCA: Ground Controlled Approach

GLACIAL DRIFT: A hydrogeologic unit consisting of glacially deposited, heterogeneous mixtures of sand, silt, clay, gravel cobbles, etc., unstratified and very compact

GYPSEOUS: Containing the mineral gypsum

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure

GROUND-WATER RESERVOIR: The earth materials and the intervening open spaces that contain ground water

HALF-LIFE: The time required for half the atoms present in radioactive substance to disintegrate

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material

HAZARDOUS MATERIAL: A material defined as hazardous under RCRA or CERCLA

HAZARDOUS WASTE: A solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations

HQ: *Headquarters*

HWMF: Hazardous Waste Management Facility

HYDROCHEMICAL PROPERTIES: The physical and chemical characteristics of a pollutant that govern its mobility in the ground-water system

ILS: Instrument Landing System

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the Air, Human Health, and Environmental Standard

INFILTRATION: The flow of liquid through pores or small openings

IRP: Installation Restoration Program

ISOTOPE: Two or more species of atoms of the same chemical element, with the same atomic number and place in the periodic table, and nearly identical chemical properties, but with different atomic mass numbers and different physical properties; an example may be the radioactive isotope - Carbon (12) and Carbon-14

JEFM: Jet Engine Field Maintenance

kg: Kilogram

km: Kilometer

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water

LINER: A continous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate

MAGMA: Mobilized molten rock

MATS: Materiel Squadron

mg/l: Milligrams per liter

ml: Milliliter

mm: Millimeter

MGD: Million gallons per day

MOA: Military Operating Area

MONITORING WELL: A well used to measure ground-water levels and to obtain water-quality samples

MSL: Mean Sea Level

NORAD: North American Air Defense Command

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon

PCB: Polychlorinated Biphenyls are highly toxic to aquatic life; they persist in the environment for long periods and are biologically accumulative

PENEPLAIN: Surface of regional extent eroded by conventional processes over long time periods to approximately equal elevations.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil

PD-680: Cleaning solvent

pH: Negative logarithm of hydrogen ion concentration

PL: Public Law

POL: Petroleum, Oils and Lubricants

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose

PMEL: Precision Maintenance Equipment Laboratory

PS-661: A cleaning agent

RCRA: Resource Conservation and Recovery Act

RECHARGE AREA: An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers

RECHARGE: The addition of water to the ground-water system by natural or artificial processes

RD: Radioactive disposal site

S: Storage site

SAGE: Semi-Automatic Ground Environment

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes enviromental hazards

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water

SD: Sludge drying bed

SDA: Sludge drying area

SLUDGE: The solid residue resulting from a manufacturing or wastewater treatment process which also produces a liquid stream

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water suply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923)

SP: Spill Area

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous waste

TAC: Tactical Air Command

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism

TRANSMISSIVITY: The rate at which water is transmitted through a unit width under a unit hydraulic gradient

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous

TRG: Tactical Reconnaissance Group
TVOR: Terminal VHF Omni-Range

μg/l: Micrograms per liter

UNCONSOLIDATED UNIT: Generally uncemented and unstructured earthen materials

USAF: United States Air Force

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere

WPC: Water Pollution Control

APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

Hazard Chemicals Data Book, Edited by G. Weiss, Noyes Data Corporation, Park Ridge, New Jersey. 1980.

Kanivetsky, Roman, Hydrogeologic Map of Minnesota: Bedlock Hydrogeology, Minnesota Geological Survey Map S-2. 1978.

Kanivetsky, Roman, Hydrogeologic Map of Minnesota: Quarterly Hydrogeology, Minnesota Geological Survey Map S-3. 1979.

Lindholm, G. F., Ericson, D. W., Bronssard, W. L., and Hult, M. F., Waste Regions of the St. Louis River Watershed, Northeast Minnesota, U. S. Geological Survey Hydeologic Investigations Atlas HA-586. 1979.

McSwinney, Peter, Assistant Scientist, Minnesota Geological Survey, Personal Communication, St. Paul. January 5, 1982.

Minnesota Code of Agency Rules, Pollution Control Agency, Division of Water Quality, New York Office of the State Register, Department of Administration. 1978.

Morey, G. B., Olsen, B. M., Southwick, D. L., Geologic Map of Minnesota: East Central Minnesota, Minnesota Geologic Survey, St. Paul. 1981.

Musick, Timothy A., Pollution Control Specialist, Duluth Regional Office, Minnesota Pollution Control Agency. January 6, 1982.

Olcott, P. G., Ericson, D. W., Felsheim, P. E., and Bronssard, W. L., Water Resources of the Lake Superior Watershed, Northeast Minnesota, U. S. Geological Survey Hydeologic Investigations Atlas HA-582. 1978.

USDA, Soil Conservation Service, Duluth Air Force Base Soil Maps. 1981.

Weist, William G., Jr., Summary Appraisals of the Nation's Ground-Water Resources - Great Lakes Region, U. S. Geological Surveys Professional Papers 813-J. 1978.

Water Quality Criteria Documents: Availability, Federal Register. Friday, November 20, 1980.

The following articles were published in Sims, P. K., Morey, G. B., eds., Geology of Minnesota: A Centennial Volume, Minnesota Geological Survey, St. Paul:

Bonnichsen, Bill, Southern Part of the Duluth Complex, pp 361-387.

Green, J. C., General Geology, Northeastern Minnesota, pp 292-293.

Hogberg, Rudolph K., Ground-Water Resources in Minnesota, pp 595-604.

Phinner, W. C., Duluth Complex, History and Nomenclature, pp 333-334.

Sims, P. K., and Morey, G. B., Resume of Geology of Minnesota, pp 3-17.

Wright, H. E., Jr., Physiography of Minnesota, pp 561-580.

Wright, H. E., Jr., Quatasnary History of Minnesota, pp 515-547.